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Correspondence.—Wishing to make this JOURNAL a gazette of intelligent discussion to those of our readers who may wish to gain or give information on the subjects to which its columns are devoted, correspondence is solicited for publication from all who make the study of those subjects a pleasure or a profession.

The Public Lighting Tables of the American Meter Company will be found in the page advertisement of that Company.

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[OFFICIAL NOTICE.]

Fourth Annual Meeting, Pacific Coast Gas Association.

OFFICE OF THE SECRETARY, OAKLAND, CAL., June 10, 1896.

The fourth annual meeting of the Pacific Coast Gas Association will be held at the office of the San Francisco Gas Light Company, corner of First and Natoma streets, San Francisco, Cal., July 21st and 22d, 1896. The headquarters will be in Parlor "C," Palace Hotel. The Secretary will be in attendance at headquarters from 10 A.M., Monday, July 20th. The sessions will be convened at 10.30 A.M. and 2 P.M. The following papers will be read:

"The Economy of Coals," by Mr. John L. Howard, San Francisco, Cal.

"The Relative Position of Consolidated Gas and Electric Light Plants," by Mr. M. C. Osborn, Santa Cruz, Cal.

"Oil Tar and its Uses," by Mr. J. B. Grimwood, San Francisco, Cal.

"Telescoping a Single Lift Holder while in Use," by Mr. J. L. Fogg, San Francisco, Cal.

"Gas Stoves," by Mr. D. Decker, Fresno, Cal.

"Municipal Ownership," by Mr. John A. Britton, Oakland, Cal.

"Evolution of a Gas Meter," by Mr. Chas. H. Dickey, Baltimore, Md.

"Wrinkles," edited by Mr. T. R. Parker, Napa, Cal.

"Experiences," edited by Mr. John Clement, Red Bluff, Cal.

"Question Box."

In addition to the papers mentioned, there will be an exhibition of acetylene gas and of the Roentgen rays during the progress of the meeting.

A meeting of the Board of Directors will be held at headquarters, Monday, July 20th, at 8 P.M. The annual banquet will be held in the Palace Hotel, at 8 P.M., of Wednesday, July 22d. Thursday, July 23d, will be devoted to the social part of the meeting, which is to consist of an excursion over the electric scenic road now being built to the summit of Mount Tamalpais. The Question Box is now ready for such questions as members may choose to propound.

JOHN A. BRITTON, Secretary.

BRIEFLY TOLD.

THE PACIFIC COAST ASSOCIATION MEETING.—A reference to the matter in the official circular forwarded us by Secretary Britton, respecting the fourth annual meeting of the Pacific Coast Gas Association, is sufficient to show that vitality marks the growth in years of the Association, and proves that its founders were wise in their judgment that the gas men of the Coast could and would give loyal support to a Society that represented their aims. Secretary Britton's notice shows the titles of 7 papers, and it may be taken for granted that President Jones, in his address, will have something of moment to say; that he will "say" it well is not controvertible. In view of all the promise thus early held out for a successful meeting, we think it fair to assume that the Pacific's membership list will be strengthened by many new names next July; and we further believe that every working gas man on the Coast would find profit to himself in being enrolled thereon.

THE LOSS TO THE LACLEDE COMPANY FROM THE RECENT CYCLONE.—The newspaper accounts of the damage to the plant of the Laclede Gas Light Company, resulting from the terrible strife of the elements in and around St. Louis, on May 27th, were so varying and emotional that we preferred to obtain an authenticated account of the Company's losses, even if time in reporting the damage done to it were seemingly lost, rather than to trust to chance in our account, with a view to being first in the field with the "news." In any event, we print the following letter, received in response to an inquiry of ours, from Mr. B. E. Chollar, the Laclede Company's Engineer:

ST. LOUIS, MO., June 9th, 1896.

To the Editor AMERICAN GAS LIGHT JOURNAL: The newspaper accounts of the damage to our property by the cyclone were greatly exaggerated, and we have consequently received many expressions of condolence and sympathy for our terrible affliction. We ourselves, however, have not worried a minute, but got right at work. The city was not short of gas one hour. A close examination of our damaged stations has shown that the money loss to the Company will be less than one-half our first estimate. The frame of the 2-lift 1,000,000-foot holder at the 14th street station was completely carried away, every one of the 12 columns having been broken off squarely at the base. The top of one of the columns cut its way, from top to bottom, of the front wall of a two-story building across the street, and one of the girders was driven like a spear through the roof of the same building. The lower section of the holder is battered up, like an old hat, and lies mostly in the tank inside of the upper section. The holder will need a new frame and lower section; the upper one will be nearly all saved. The damage to the Convent street Station, with the exception of the stables and end wall of one of the retort houses, was mostly confined to the roofs, almost all of which were *de-slated* in less time than it takes to say it. We are well underway with repairing it, and in a short time it will be in as good shape as ever. In a few days I will send you a dozen photographs, taken the next day after the storm.

Yours truly, B. E. CHOLLAR.

NOTES.—Mr. C. R. Collins, formerly with the United Gas Improvement Company, has been appointed General Manager of the Seattle (Wash.) Gas and Electric Light Company. We congratulate the Company over having secured the services of such a capable and well-balanced man.——Elsewhere we note the election of Directors for the ensuing year in the Pawtucket (R. I.) Gas Company. The Directors subsequently organized by naming the following officers: President, Lyman M. Darling; Secretary, Edwin A. Perrin; Superintendent, William McGregor; Collector, George A. Stiness. As was thought would be the case, the Board considered the matter of a reduction in the gas rates, and the result of the deliberation is reported to have been an agreement to institute the following schedule, the same to go into effect July 1st: An annual consumption of 1,000,000 to 3,000,000 cubic feet, $1.35 per 1,000; 500,000 to 1,000,000 cubic feet, $1.40 per 1,000; 35,000 to 500,000 cubic feet, $1.45 per 1,000; up to 35,000, $1.50 per 1,000. For cooking, heating and power use, $1.25 per 1,000. A discount of 10 cents per 1,000 will be allowed on all bills paid before the 24th day of the month in which the accounts are rendered.——The proprietors of the Norristown (Pa.) Gas Company have announced that, on and after July 1st, the selling rate will rule at $1.30 per 1,000 cubic feet, a concession of 30 cents per 1,000.

Correspondence

[The JOURNAL is not responsible for the opinions expressed by correspondents.]

Mr. T. A. Bates has Cause for Surprise.

LA CROSSE GAS LIGHT COMPANY,
LA CROSSE, WIS., June 8, 1896.

To the Editor AMERICAN GAS LIGHT JOURNAL: I was surprised at the statement made at the Chattanooga meeting by Mr. Jenkins, of Covington, Ky., during the discussion of Mr. Gimper's paper on "Naphthaline," to learn that Mr. Light, of Dayton, O., was passing gas from station meter at 75°, and delivering into holder at 45° lower—viz., 30°. The statement not being questioned, the conclusion was that my ears had played me false. Your report of the proceedings, however, confirmed my first impression. There are two points in connection with this statement I have curiosity to see explained. We may reasonably assume that to reduce temperature of gas between meter and holder 45° would require the inlet pipe of holder to be of far lower temperature than 30°, as chief cooling must take place there. How, then, did Mr. Light work his holder? as ice must have been *solid* to the bottom of the tank. In the second place, how does Mr. Light succeed in reducing temperature in bottom of tank to 30° or lower? Over 20 years ago I placed my first water cooler in tank. The temperature obtained at bottom was 52° in March, 58° in September. Tests since then, in a number of localities, have never developed lower, nor to exceed 7° higher, temperature—viz., 65°. Depth of tanks, ranging from 20 feet to 26 feet.

Very respectfully,

T. A. BATES.

[Prepared for the JOURNAL by MR. H. K. LANDIS.]

Liquefaction in Compressing Gas.

In a series of tests recently made for the Lehigh Valley Railroad, to determine the relative cost of Pintsch and city gas in Pintsch-Argand, Pintsch 4-flat flame, and Gordon-Mitchell lamps for their passenger car service, a number of interesting facts were brought to light. A report upon these tests, by Professor W. H. Chandler, of Lehigh University, and Professor Denton, of Stevens Institute, gives the data and conclusions in detail, from which the following facts are derived: In compressing Jersey City gas it was found that the gas in the reservoirs did not equal the cylinder displacement; air was, therefore, compressed, and no loss found in the compressor or the reservoirs. When city gas was tried it was found that there was a loss of volume of 6.6 per cent. and a liquid deposit of 3.2 lbs. per 1,000 cubic feet of gas compressed. Pintsch gas was then tested at a plant which has been in operation about five years, charging 100 passenger cars up to 14 atmospheres each day. The results, which extend over a wide range of time, are bound to be a good average in consequence. It was found that 14 per cent. of the volume of Pintsch gas was lost by compressing up to 14 atmospheres, resulting in a liquid deposit of 8.72 lbs. per 1,000 cubic feet of gas compressed. An additional loss of 14 per cent. was found in the hose connections and imperfect charging devices, making a total loss of about 20 per cent. with city gas and 28 per cent. with Pintsch gas.

On the occasion of some shrinkage tests, made on December 22d, 1895, at the shops of the Delaware, Lackawanna and Western Railroad, Pintsch gas gave the following results: Meters "are seldom what they seem," and are prolific in "ways that are dark and tricks that are vain." This particular one had a constant of 0.94, which was determined by comparison with the gasholder. The gas was compressed into a reservoir of 265 cubic feet capacity, connected with a drip-pot of 3.45 cubic feet capacity, empty at the start, and was not connected with the large reservoir until the pressure in both had reached 12 atmospheres; they were both then run up to 14 atmospheres and the following results observed:

Gas delivered through meter, corrected.....	376	cubic feet.
Gas delivered from gasometer.....	293	"
Total entering compressor.....	669	cubic feet.
Gas received in large reservoir, 265 × 2 = 530		
Gas received in drip-pot, 14 × 3.45 = ... 48		
—— 578		"
Loss by shrinkage.....	91	cubic feet.
Per cent. of loss by shrinkage, 91 ÷ 669..	13.6	per cent.

—or, not far from the 14 per cent. subsequently determined from long periods of observation. These figures are important as being the principal source of loss in compression which no mechanical contrivance can overcome. Variation in the richness of a gas due to some irregularity of manufacture is often an annoyance, especially in making tests. These arise principally from variations in the crude materials used. A new shipment of poor petroleum may cause a Pintsch gas to fall as much as 25 per cent. in candle power. In Jersey City gas, as experimented with by Prof. Jacobus, the variation in candle power was as much as 36 per cent. below the maximum, due to the breaking-in of a new shipment of naphtha to the gas works. The principal fluctuations are given below:

Date of Test. 1895.	Candle Power Per Ct. of Maximum.	Date of Test. 1895.	Candle Power Per Ct. of Maximum.
May 11	100.0	August 7	64.4
" 16.....	97.5	" 12.....	75.3
" 20.....	80.0	" 13.....	74.5
" 24.....	96.4	" 28.....	76.0

The conclusions arrived at by Professors Chandler and Denton may be summarized in the following table, giving the annual cost of illuminating for a car service consuming 6,199,525 cubic feet of Jersey City gas, in Gordon-Mitchell lamps, using 7.6 cubic feet of gas per hour. This city gas costs $1.50 per 1,000 in the mains, and $2.883 compressed

to 270 lbs., in the car tanks, Pintsch gas being delivered by contract for $5.09 per 1,000 cubic feet.

Kind of Lamp.	Kind of Gas.	Cu. Ft. of Gas Consumed per Hour.	Cubic Feet of Gas Consumed per Annum.	Candle Power 45° Below the Horizontal.	Annual Cost of Gas.
Gordon-Mitchell....	Jersey City....	7.60	6,199,525	29	$17,873
Pintsch-Argand	"	7.13	5,815,254	30	16,765
" " ..	Pintsch from D.,L. & W.RR.	3.41	2,781,629	54	14,158
Gordon-Mitchell...	Ditto.	3.36	2,823,353	26	13,964
Pintsch 4-flat flame.	Ditto.	3.31	2,702,993	35	13,758
" " " .	Ditto.	2.79	2,275,879	29	11,558

The consumption of 18,872 cubic feet per 24 hours is on the basis of the Lehigh Valley requirements at Easton, Pa., for 70 day coaches, 7 sleepers and 3 chair cars daily, having 5, 10 and 8 lamps each, respectively.

It will be seen that, for a single road, the compression losses of 6.6 per cent. and 14 per cent. are quite an item.

Acting-Governor Wolcott's Veto of the Massachusetts Pipe Line Company's Bill.

The following is the text of the veto submitted by the Acting-Governor of Massachusetts (Mr. Roger Wolcott), in respect of the bill passed by the Legislature, chartering the Massachusetts Pipe Line Company:

I return herewith an act to incorporate the Massachusetts Pipe Line Company, with my objections thereto in writing.

The powers and privileges granted to the corporation are far more extensive than the title of the act would indicate. It is not a pipe line company merely. It is a gas company, with privileges far more reaching than have ever heretofore been granted to a Massachusetts corporation. The six persons named, their associates and successors, are granted a charter with a capital which may be indefinitely increased. They may engage in the business of manufacturing gas for all purposes, of all kinds, by any method and in all parts of the Commonwealth. Under this bill they may establish gas works in every city and town in the State. They may lay pipe lines for the conveyance of gas in every highway.

Their right to lay such pipe lines not only from town to town, but within the same town, wherever they see fit to connect one pipe line with another, or with a distributing system, is absolute, and not subject to the prohibition or control of any authority whatever, excepting as to mere details of location. They may, with the approval of the municipal authorities or the Board of Gas Commissioners, engage in the business of selling gas to private consumers and lay pipes therefor in any town or city in the State.

Although, under the well-settled policy of Massachusetts, a municipality may not engage in the business of furnishing gas to consumers without purchasing plants already established within its borders, this Company is under no such obligation to purchase. It is relieved of certain of the restrictions of existing laws as to the quality of the gas it may supply.

Finally, it is given the power to acquire by purchase or lease the property of all the gas companies in the State.

It is obvious that this bill is a radical departure from the well-settled policy of legislation in Massachusetts. Heretofore not only the organization of companies for the manufacture and sale of gas, but the business carried on by them, have been carefully regulated by general laws, applicable to all persons and companies alike. The limit of capital is fixed. The location and extension of pipes, involving the right of digging up public ways, are to be obtained only by permission of the local authorities; the quality and price of the gas manufactured are under the immediate control of the Commonwealth. The purchase or leasing of a gas plant by another company is practically prohibited.

In compensation for this strictness of control the right of competition, so far as it authorizes two or more distributing systems to encumber the streets of the same municipality, has been carefully restricted, and the assurance thus held out to the promoters of such enterprises that, if their business be well conducted and the quality and price of their gas satisfactory, they should be protected from destructive competition.

Upon the faith of this policy of the Commonwealth, a policy repeatedly declared by the Legislature, many millions of dollars have been invested in the business of making and distributing gas. By this bill no one of these regulations is removed from existing companies except that they may sell or lease their plant to the Massachusetts Pipe Line Company. The established policy of the Commonwealth as to other gas companies remains unchanged. But the bill gives to this Company a charter empowering it to compete throughout the State with existing companies, handicapped as these companies necessarily would be by restrictions and regulations in force as to them, but from many of which these incorporators are exempt.

I feel justified in saying that rights and privileges so exceptional should not be granted to any body of men without the clearest assurance of benefit to the public. It is a fundamental principle of the organic law of Massachusetts that "no man or corporation or association has any other title to obtain advantages or particular and exclusive privileges distinct from those of the community than what arises from the consideration of service rendered the public." The only ground upon which this bill can stand is that by its passage the price of gas will be made cheaper to the public. But, upon examination of its provisions, I find no such assurance. The only provisions which relate to the price of gas are, first, that when the Company purchases an existing plant it shall not increase the price of gas; second, that when it engages in the business of selling gas to the consumer on its own account its prices shall be subject to the jurisdiction of the Gas Commissioners, as those of existing companies now are; and, third, that when it sells gas to a corporation or municipality, the price of gas delivered to the holder or distributing system of such company or municipality shall not exceed 35 cents per 1,000 cubic feet.

It is obvious that the two provisions first named do not insure cheaper gas to the customer. There is no promise of reduction of price in case of purchase of another plant, and there is no obligation on the Company, in case it sells gas to the consumer on its own account, to sell at any cheaper rate than do existing companies. Indeed, the petitioners, as I am informed, have expressly disclaimed any such assurance.

When an amendment was adopted in the House of Representatives limiting the price of gas to consumers at 50 cents, it was frankly stated by the friends of the bill that a charter with that provision would be of no benefit to the promoters. Even a proposition which was made in the Senate to limit the price to consumers at 90 cents, a sum not greatly less than the present average price of gas to consumers in this State, was defeated by the friends of the bill.

The only possible ground upon which it can be claimed that the bill affords any assurance of cheaper gas is the clause which limits the price to 35 cents per 1,000 feet when delivered to the holder or distributing system of a city or town or of another company. But this limitation does not necessarily reach the consumer. It is matter of common knowledge that a very considerable portion of the expense of gas to the consumer is in the distribution; and it is asserted that the average cost of gas of standard illuminating power in the holder does not greatly exceed 35 cents, and that if the restrictions as to illuminating power were removed, as is permitted to this Company, a much cheaper price in the holder might be obtained. Moreover, many of the extraordinary privileges granted by this bill, such as the right to purchase or lease the property of companies already established, and the roving commission to engage in the gas business throughout the Commonwealth, in competition with existing companies, have no necessary relation to the pipe line business, to which alone this limit of price applies.

I am aware that the statement is made that it is hoped and expected by the promoters that, by the introduction of a kind of coal not now in general use, and by some projected improvements in methods of manufacture, the Company will be able to furnish cheap coke and cheaper gas for illuminating purposes, and especially to reduce largely the price of gas for fuel purposes. These claims are not in the bill. It is not necessary, in order to establish the truth of such claims, that a Company be granted extraordinary privileges. It is matter of common knowledge that this franchise is sought by men of wealth and enterprise, who have already under their control the largest distributing system in the Commonwealth, where every facility is afforded for the production of cheap gas, both for fuel and illuminating purposes, even to the extent of a double line of distributing pipes in many of the streets of the territory which it covers. I refer to the densely populated area now covered by the Boston Gas Light Company and the Brookline Gas Light Company.

Are the claims of these promoters verified and established upon the systems now within their control? It will be time enough, in my judgment, to grant the exceptional privileges of this bill when, in the field now controlled by them, they shall have been able to verify the claims, upon the mere promise of which they ask for this bill.

Nor can I lose sight of the fact that this bill is a grave menace to existing companies, in which the money of the citizens of Massachusetts

has been largely invested. Massachusetts owes much of her prosperity to the safeguards she has imposed upon her corporate investments. To this wise policy, under which the rights of the public and the rights of capital are both assured, she is largely indebted for her present high po sition. The Commonwealth stands pledged to the proposition that those who have risked their money in public service corporations, so long as they serve the public well and cheaply, shall not be exposed to destructive competition.

I am well aware that these considerations of regard for vested interest should have no weight when they are opposed to the welfare of the public. It is far more important that the citizens of Massachusetts should have gas for illuminating and fuel at the cheapest possible price than that the investments of shareholders in gas companies should be protected. Any measure in the interest of cheap gas is of the highest possible public benefit, and other considerations must yield to the advantage thus gained to the public. Corporate interest cannot stand against the welfare of the community.

But the only way in which this bill, otherwise than through its pipe line features, to which I have referred, can justly claim to be for the interest of the public, is in the privilege of competition it affords to the corporation it creates. That this competition may be destructive of vested rights it is not difficult to foresee. This is not alone because the promoters are men of means and enterprise, nor is it pretended that they are the exclusive possessors of any new invention or patented method which they alone can employ. The bill itself, through the exceptional privileges it grants and which are denied to its competitors, gives to this Company an undue advantage. Experience has demonstrated that unrestricted competition by public service corporations, although the temporary results may be to make cheaper prices to the public, seldom accomplishes any permanent good. The public must eventually pay the bills. I can see no permanent advantage to the community in arming this Company with a club by which it may strike down those already in the field. Temporarily it may cheapen prices; indeed, it must do so or promise to do so that it may strike them down, but the history of such competition demonstrates that eventually it is the public that suffers.

If the wise policy of Massachusetts, long established and maintained, as to its public service corporations, is to be changed, the change should be made not for the benefit of one body of men, but for all alike. If better results can be obtained for the public by competition, then it is but simple justice that the restrictions that have been established should be removed from all citizens and all corporations alike. In my opinion, it is not justice to vested rights, nor sound business policy, nor for the interests of the public to authorize the discriminations which this bill proposes to establish, especially without assurance by actual demonstration, or sufficient guaranty, that the public benefit which could alone justify them must ensue.

If the bill were limited to a pipe line charter, that is, a charter granting authority to lay pipe lines for the conveyance of gas from town to town, with the privilege of selling the product to the municipality or to existing companies, or even to consumers, if no distributing system is in the field, with suitable restrictions as to the price and quality, many, if not all, of the objections I have stated to the existing bill would be removed. Indeed, from the arguments and claims of the promoters of the enterprise which have been put in my hands for perusal, the establishment of a pipe line system appears to have been the essence of their petition. But this bill does not stop with such a system; it has added such exceptional, unnecessary and, in my judgment, injurious privileges, that in its present form I cannot give it my approval.

Efficiency of the London Argand at Different Rates of Gas Consumption, with Special Reference to Its Use as a Gas Testing Burner.

[A paper read by Mr. Lewis T. Wright before the May Meeting of the Incorporated Institution of Gas Engineers.]

That the amount of light yielded by unit volume of an illuminating gas, when being consumed in a "London" Argand burner, varies with the quantity of that gas being consumed in a given time—or, in other words, that the efficiency of the burner depends upon the rate of gas consumption—has been generally known; but the author is not aware that the burner in question has been submitted to a critical study.

In 1870, Mr. R. H. Patterson, then one of the London Gas Referees, investigated the behavior of London coal gas in this burner; and in his article "On Gas Burners and the Principles of Gas Illumination," to be found in Vol. III. of "King's Treatise on Coal Gas," he showed how much the light developed per unit volume of coal gas was affected by the rate of its consumption, and he explained (p. 84) that the maximum air supply was pretty nearly fixed by the chimney, and that by increasing the gas supply till the flame was about to smoke, the defect of over air supply, observed with low rates of gas consumption, could be remedied, and the maximum efficiency obtained. He stated, as an absolute rule for Argands, that they give the maximum yield of light per cubic foot of gas just at that rate of consumption when they are about to smoke. In the author's experience, this rule has not been found to be universally true. It certainly is not true for cannel gases of from 22 candles upwards, nor of safe application to common coal gas benzolized up to 16 candles or thereabouts, nor for common coal gas enriched with gasoline up to 18¼ candles.

It is hardly necessary, in the limits of this paper, to discuss in detail the manner in which the relation between the air supply and gas supply varies with the rate of gas consumption. The air supply is a function of the temperature generated within the chimney; and this, in its turn, depends upon the mass and quality of the combustible material being consumed in a certain time. If there were no resistance to the passage of the air by friction, the air current would by no means increase in direct proportion with the temperature, but only as the square root. Thus, if the temperature could be doubled by doubling the amount of combustible material consumed, then the air supply (ignoring friction) would only be increased about 40 per cent. Friction there is; and this increases probably as the square of the velocity of the air current.

On theoretical grounds, the air supply by no means increases in simple proportion with an increase in the consumption of gas within the chimney. At low rates of gas consumption, the air supply is in excess, and the luminous portion of the flame is relatively white; as the gas consumption increases, the air supply is less in excess, and the luminous portion of the flame becomes yellower; and finally, when the gas consumption has increased to such a point that the air supply is deficient, the flame becomes lurid and smokes.

The efficiency of a unit volume of the gas during this change in the rate of consumption has been increasing up to a certain maximum at a point somewhere less than that at which the air supply may be said to be deficient, from the point of view of smoke. After the point of maximum efficiency—which is more or less near to the smoking point, according to the composition of the gas—is reached, the further increase in the consumption of gas, which may not necessarily be attended with smoke, is accompanied with a lowering of the efficiency. This fall in the efficiency curve is important, as it happens that there are often two rates of gas consumption that will with many gases produce the same flame value. It is especially important in reference to a recommendation of the Photometric Standards Committee, "to allow the Gas Referees to sanction a mode of testing in which the gas shall be burned from the standard 'London' Argand burner at whatever rate is found requisite in order that it may give a light equal to that of the prescribed number of candles." The wording of this recommendation requires amendment; and for "whatever rate" it would be safer to substitute "the lowest rate," since there might be two rates, one on each side of the point of maximum efficiency, which would give the prescribed number of candles.

The question of the efficiency of the standard "London" Argand at various rates of gas consumption, and with gases of different qualities and composition, is worthy of discussion from several standpoints.

1.—*From the point of view of official gas testing as at present practised, either under the terms of the Gas Works Clauses Act, 1871, or under the instructions of the London Gas Referees.* For the sake of illustrating the bearing of the varying efficiency of the burner on this question of official gas testing, the author will cite the case of a gas that, if tested under such circumstances of pressure and temperature as are represented by a tabular number of 1.000, would give a light of 16 candles at the measured rate of 5 cubic feet per hour. If the conditions of temperature and pressure were changed, so that the mass in the measured rate of 5 cubic feet per hour became only 96 per cent. of what it would be if measured under standard conditions, the quantity of the combustible material is not only 4 per cent. less, but the efficiency of the burner may be so decreased that the light will be not 4, but 6 or 7 per cent. less. In a case cited by the author at the last meeting of this Institution, the light yielded was only 15 candles. The standard volume was, however, only 4.8 cubic feet; and under the instructions of the London Gas Referees, the illuminating power would, after correction to standard conditions, have been recorded as 15.6 candles.

Under the Gas Works Clauses Act, 1871, it has been decided by Magistrates that, as there is no mention in the Act of a correction for variations of conditions of temperature and pressure from standard

conditions, no such correction can be applied. The true 16-candle gas might be, therefore, with tabular number 0.960, reported as 15 candles under the Gas Works Clauses Act, and 15.6 candles under the Instructions of the London Gas Referees, or even less. On the other hand, if the conditions of pressure and temperature were represented by a tabular number of 1.020 the gas might, under the Instructions of the London Gas Referees, appear as 16.6 candles, and under the Gas Works Clauses Act as 17 candles.

The application of a correction to bring the volume of gas consumed to standard conditions, adjusts differences due to variations in pressure and temperature, but it does not touch variations in the efficiency of the Argand burner at various rates of consumption.

2.—*From the point of view of the desire of some authorities to test the gas under those conditions that will consume it in the burner at the maximum efficiency.* This has been stated by Mr. Patterson as an absolute rule, for Argands to be at the point when any further supply of gas would produce smoking. The principle, though very often true for ordinary qualities of 16-candle coal gas and less, is not always so; and the author has encountered very many exceptions. Since the point when any further gas consumption will produce smoke is not necessarily that of maximum efficiency, by what means can that desired point be found? To prescribe that the chimney shall be full of flame is not practicable, as with some gases it might, if literally carried out, produce a flame manifestly smoky. It is possible to prescribe that the flame shall be such that any further increase in the gas consumption shall cause it to "tail" or "fork" above the chimney; but this point may or may not be the point of maximum efficiency.

Though these questions at first affect London gas alone, it cannot but be believed that any practice adopted in the Metropolis as a standard method or system of photometry would later be generally accepted, not only for official gas testing, but also as a practice in investigations and inquiries of a scientific nature. To prescribe, therefore, that the gas shall be tested at the consumption of maximum efficiency would, failing some criterion by which this point could be easily defined, be impracticable. While searching for the point of maximum efficiency the gas supply might be continually changing; and the conscientious gas tester might never find it. To prescribe that it shall be tested with the chimney full of gas is a condition that, if literally carried out, would often be very prejudicial to the gas.

3.—*From the point of view of those who would test the gas at some standard height of flame.* This proposal the author considers impracticable, as the end of an Argand flame is ragged; and two persons might quite conscientiously differ very much as to what might be the true height of an Argand flame.

4.—*From the point of view of those who propose to test the gas at a constant flame value of (say) 16 candles.* This proposal is only practicable if some invariable standard of light can be found, by comparison with which, at any time and place, the required flame value can be obtained. The 10-candle Dibdin standard is reported as providing this means of finding a flame value.

It is interesting to know whether, at any determined flame value (say, that of 16 candles), the "London" Argand burner will be developing the maximum efficiency from the gas, or, if not, what percentage of the maximum efficiency is developed. The question whether the Dibdin 10-candle standard provides a means by which a constant flame value can be found at any time and place comes, it is believed, within the scope of this paper; and the author, for that reason, gives an account of some experiments he has made with the new standard.

In some recent experiments on burner efficiencies at various rates of gas consumption the author has made use of the Dibdin 10 candle standard of light. This standard is based on a principle that many could not *a priori* accept—viz., that the light exposed by the 2.15-inch screen is constant, whether the pentane be carried in air or coal gas, and within wide limits—both as to degree of pentane saturation and in height of flame, varying between 2½ and 5 inches.

It may be mentioned that in every case when the standards were fed directly from the carbureters the flames required constant attention in order to maintain them at their normal height. This variation is believed not to be due to changes in the pressure of the gasholder delivering the air. This frequent adjustment of the flame, which, in the author's experience, is necessary to maintain the light constant, is disturbing, and really requires the services of an assistant.

It was found, by carbureting the gas or air into a test gasholder, and feeding the standards from this, that flames of constant height could be maintained. It was discovered that the pentane gas or pentane air so prepared differed more or less widely from the product obtained by directly feeding the flames from the carbureters. The intensities of the flames were also different. These variations are attributed to differences both in the degree of pentane saturation and the behavior of gas and air as a carrier.

The author did not concern himself with the verification of the value of the light passing the 2.15-inch screen in terms of standard sperm candles, but accepted either one or other of the standards compared as being 10 candles. The standards answered the specification.

It was decided to ascertain (*a*) whether coal gas was the equivalent of air as a carrier; (*b*) whether the light was influenced by the temperature of the carbureter; (*c*) whether the light was influenced by the height of flame in the burner. It was determined to adhere in these trials to the principle of not comparing the standards against some other source of light which *prima facie* might be said to be less constant than a 10-candle standard, as all variations might then have been attributed to this other source of light. In all the trials on the behavior of the standards one was compared with another. In that case any variation must proceed from one or other or both of the standards.

Sensitiveness of Eyes and Disc.

Experiments were made at various times to ascertain over what range one of the lights might be moved without producing any perceptible alteration in the equality of illumination of the two sides of the disc. It was found generally that, with one 10-candle standard, with carefully adjusted and steady flame placed on the 1.6-candle mark of an Evans photometer (16 candles), and with another 10-candle standard with equally steady flame placed on the other side, the range over which it could be moved without disturbing the apparent equal illumination was 0.3 of a candle. This was the extent of the neutral range within which no difference in the illumination of the disc could be perceived.

In practice. it was found, on inspecting a large number of tests of ten observations (five on either side of the disc), that there was an extreme difference of 0.30 of a candle, while the least extreme difference was 0.10 of a candle. If the truth were half way between extreme readings it would appear that any single observation might vary 0.15 of a candle from the truth.

In the case of experiments (averages of ten observations) made in duplicate, with all conditions apparently alike in each of the pair, it was found that the extreme difference between any two of a pair was 0.18 of a candle, and the least difference 0.03 of a candle, with the intensity of illuminating in the disc equal to a light of 16 candles 50 inches away, as in the case of the testing of 16-candle gas. While the neutral distance at that intensity is 0.3 of a candle, in practice it appeared to average but 0.22 of a candle—that being the average of a large number of extremes found in sets of five readings. It is therefore not claimed in this paper that phenomenal agreement between single observations, or even between averages of ten (five on either side of disc), can be obtained.

Preliminary trials showed that two standards answering the specification did not agree with each other under all circumstances when the conditions under which each was fed with illuminant were either identical or normal according to the instructions. That is, when both were supplied either direct from their respective carbureters, under the conditions prescribed with air pentane, or when they were both supplied from a common stock of either air pentane or coal gas pentane, there was a difference; but this difference depended on the sides of the photometer in which they were placed. The photometer was an Evans 100-inch, with stationary disc. Pains were taken to ascertain the cause or causes of this difference in the behavior of the two standardss, but in vain; and the difference could not be mitigated, but remained the same when other conditions were constant.

Experiments Made to Ascertain whether Coal Gas is the Equivalent of Air as a Carrier of the Pentane Vapor.

Series A.—A 10-candle standard, marked "No. 2 N.," being taken as the standard, is placed and kept at the 1.6 candle mark on the left hand side of the photometer. This is the position the standard would occupy in testing 16-candle gas. This 1.6-candle mark, as well as the one on the other side, and also the pointers on the candle carriages on which the standards were placed, were carefully verified with relation to the middle of the photometer and the disc. Another 10-candle standard, without number, but described in this paper as "S.N.," is placed on the right-hand side, and moved to give equality of illumination on the disc. The carbureters are placed on the table below the photometer. The numbers in brackets represent the order in which the experiments were made. Each result is the average of ten observations (disc and mirrors reversed at the fifth):

Left Hand.		Right Hand.	Candles.
(1) 2 N. at 16c., fed with air pentane.		S.N. gas pentane.....	15.30
(2) 2 N. " " "		S.N. air pentane.....	16.12
(3) 2 N. " " gas pentane.		S.N. gas pentane.....	15.79
(4) 2 N. " " "		S.N. air pentane.....	16.38

Gas pentane is better than air pentane in standard S.N. by 0.82 candle (1 and 2). Gas pentane is better than air pentane in standard S.N. by 0.59 candle (3 and 4). Gas pentane is better than air pentane in standard 2 N. by 0.49 candle (1 and 3). Gas pentane is better than air pentane in standard 2 N. by 0.26 candle (2 and 4). The two standards are not affected by the change from air pentane to gas pentane in an equal manner. The standard S. N. being more sensitive to the change.

Series B.—This series was not made on the same day; and though the coal gas employed was approximately the same as regards candle power, it was not, of course, the same gas. The S.N. standard is, in this series, taken as the standard, and kept at the 1.6-candle mark (16 candles) on the left-hand side of the photometer. The 2 N. standard on the right hand side is moved:

Left Hand.		Right Hand.	Candles.
(5) S.N. at 16c., fed with gas pentane.		2 N. air pentane.....	16.48
(2) S.N. " " "		2 N. "	16.36
(6) S.N. " " "		2 N. gas pentane.....	16.58
(3) S.N. " " "		2 N. "	16.63
(1) S.N. " " air pentane.		2 N. "	17.35
(4) S.N. " " "		2 N. "	17.47

The tests (ten observations, disc and mirrors reversed at the fifth) are in duplicate, though the two numbers of the pair were not consecutive, as will be seen by the numbers in brackets. They show that changing from air pentane to gas pentane made the 2 N. standard 0.18 candle (average of duplicate experiments) worse. The change from air pentane to gas pentane made the S.N. standard 0.81 candle worse. The effect is in this series the reverse of that found in series A; but, as in that series, the change is notably more marked on the S.N. standards.

Other trials have convinced the author of this paper that coal gas cannot be accepted as the equivalent of air as a carrier of the pentane vapor.

Experiments as Regards Position.

Series C.—Both standards were fed with air pentane directly from carbureters placed on the table below. The reversal in the positions of the standards was confined to the standards which were lifted out of the sockets on the carriages.

Left Hand.	Right Hand.
(1) 2 N. at 16 candles.	S.N. 16.00 candles.
(3) 2 N. " "	S.N. 16.10 "
(2) S.N. " "	2 N. 17.03 "
(4) S.N. " "	2 N. 17.25 "

Experiments Nos. 1 and 3 of this series agree closely with experiment No. 2 of series A, the conditions of which are the same. When the positions of the standards are reversed, and the conditions the same, the divergence is very great—in this case 1.09 candles.

Series D.—The standards were now fed from a stock of air pentane prepared in a 5 cubic feet standard gasholder, by passing air through a carbureter belonging to one of the standards. Each result is the average of 10 observations as before.

Left Hand.	Right Hand.
(1) 2 N. at 16 candles.	S.N. 15.84 candles.
(3) 2 N. " "	S.N. 15.81 "
(2) S.N. " "	2 N. 17.04 "
(4) S.N. " "	2 N. 17.19 "

The agreement between the members of each pair is considered to be satisfactory. The 2 N. standard was still fed from the same stock of air pentane prepared in the gasholder; but the S.N. standard was then fed with air pentane direct from the carbureter. The result was now—

Left Hand.	Right Hand.
(5) S.N. at 16 c. direct from carbureter.	2 N. 15.60 candles.

In carbureting directly to the standard, the passage of the air through the carbureter was much slower than when the stock of air pentane was prepared in the gasholder, and a flame richer in carbon was obtained. The difference in the intensity of the flames from the two qualities of air pentane burning in the S.N. standard is in this case 1.51 candles, and is due to the lowering of the intensity due to increase in the pentane saturation. The difference in value of the standard in this as in other similar cases was accompanied by a difference in the color of the light discernible, not only by direct observation, but by the color of the disc.

Series E.—The gasholder was again filled with a fresh stock of air pentane, and the standards were reversed. The readings were now (10 observations)—

Left Hand.	Right Hand.
(1) 2 N. at 16 candles.	S.N. at 14.96 candles.

With this mixture, the S.N. standard was 1.04 candles better than the 2 N. The 2 N. was still fed with air pentane from the same stock, and the S.N. was fed with the same stock repassed through the carbureter at normal speed. The readings were then—

Left Hand.	Right Hand.
(2) 2 N. at 16 candles.	S.N. at 15.87 candles.

Recarbureting the air pentane to the S.N. standard, which presumably would increase the degree of pentane saturation, lowered the light in it 0.91 candle, and at the same time made it yellower.

The carbureter feeding the S.N. standard with the air pentane stock in the gas gasholders was surrounded with ice to reduce the degree of pentane saturation. The readings were now—

Left Hand.	Right Hand.
(3) 2 N. at 16 candles.	S.N. at 15.37 candles.

The ice had presumably reduced the pentane saturation, and the light was thereby increased 0.5 candle.

The standard 2 N. was still fed from the stock in the gasholder precisely as in experiments 1, 2 and 3; but S.N. was now fed with air direct to the carbureter still surrounded with ice. No change was produced, as with the carbureter surrounded with ice it made no difference whether or not the air had been previously carbureted before being passed through the carbureter connected with the S.N. standard. The readings were—

Left Hand.	Right Hand.
(4) 2 N. at 16 candles.	S.N. at 15.30 candles.

Experiments to Determine the Influence of the Temperature of the Carbureter on the Intensity of the Flame from a 10-Candle Standard.

Series E.—The standard S.N., was fed from a supply of air pentane stored in a 5 cubic feet gasholder. The standard 2 N. was kept at the 1.6 candle mark on the left hand, and fed with air through the carbureter in accordance with the instructions. The temperature of this carbureter was varied by surrounding it with a bath, the water in which was kept at various temperatures.

Left Hand.	Temperature of Carbureter.	Right Hand.
2 N. at 16 candles.	68° F.	S.N. at 15.50 candles.
2 N. " "	56 "	S.N. at 15.60 "
2 N. " "	89 "	S.N. at 14.95 "
2 N. " "	95 "	S.N. at 14.50 "
2 N. " "	44 "	S.N. at 15.60 "
2 N. " "	39 "	S.N. at 15.45 "

At 89° and 95° F. the light from the 2 N. standard was seriously depreciated.

Experiments as to Height of Flame in the Standard.

Series F.—In Section VII. of the report of the Photometric Standard Committee, it is stated that Mr. Dibdin found that the luminosity of the portion of the flame exposed by the screen remains constant even under considerable variations in the total heights of the flame; and in his recent paper, read before the Society of Arts, the inventor of this standard said that between a height of flame of 2.5 and 5 inches there is no perceptible variation in the light from the standards. However, the Secretary of the Committee, in his paper on "The Work of the Photometric Standard Committee," says that with "extreme variations in the flame, such as could only be obtained with gross carelessness, the variation in the amount of light was but small; and when such variations did take place, the light emitted by the standard was less than 10 candles."

The end of the flame is ragged, and in finding the height, or in adjusting to the 3-inch normal height, the mean, and not the extremes, of the forks is taken as the height of the flame. These forks at the end of the flame are continually altering their position and size. Thus any adjustment of the flame is relative.

The following experiments were made with adjustments 0.3 inch high and low:

Left Hand. Flame.	Right Hand. Flame.
(1) 2 N. at 16 c. 0.3 inch high.	S.N. 0.3 inch low at 15.92 c.
(2) 2 N. " " low.	S.N. 0.3 inch high at 15.28 c.
(3) 2 N. " normal.	S.N. normal at 15.79 c.

In the above, the standards were supplied with gas pentane through the carbureters.

Series G.—In this series both standards were fed from a stock of air pentane stored in a gasholder, prepared by carbureting air through one of the carbureters.

	Left Hand Flame.	Right Hand Flame.
(1)	2 N. at 16 c. normal.	S.N. normal at 14.96 c.
(2)	2 N. " 0.3 inch high.	S.N. " 14.87 c.
(3)	2 N. " 0.3 inch low.	S.N. " 14.37 c.
(4)	2 N. " normal.	S.N. 0.3 inch low at 15.20 c.
(5)	2 N. " "	S.N. 0.3 inch high at 15.08 c.

In this series the lowering of the flame 0.3 inch in standard 2 N. reduced the light 0.59 candle. Lowering the flame 0.3 inch in standard S.N. reduced the light 0.24 candle. Raising the flame 0.3 inch in 2 N. reduced the light 0.09 candle. Raising the flame in S.N. 0.3 inch reduced the light 0.12 candle.

Other trials made with the standards 50 inches from the disc showed that raising one flame 0.3 inch and lowering the other 0.3 inch produced a difference in the light of 0.6 candle.

The two standards, when fed from the carbureters with air pentane, are nearly equal in a certain position—viz., 2 N., on the left hand and S.N. on the right. This equality is no longer observed when the positions are reversed, with S.N. on the left hand and 2 N. on the right hand. 2 N. would make S.N. appear as 17 to 17.3 candles when S.N. is on the 1.6 mark (16 candles.)

That the difference in the behavior in the standards in different positions is not due to the scale is as easily proved. It is also apparent at whatever distance the flames may be from the disc within the limits of the scale. It is not due to unequal reflection from the sides of the photometer, as blackened screens were inserted to shut off any possible reflection from this source. It was not due to the glass chimneys. When these two standards were taken to another laboratory and placed on a Letheby photometer, they were nearly equal in both positions; but 2 N. was compared with another standard used with this Letheby photometer, and it was found to be equal in one position, but 0.8 candle better in the other. The two standards, 2 N. and S.N., taken back to the Evans photometer, still behaved as before; but the difference depends somewhat on the class of pentane gas with which they may be fed.

During the experiments described the author had the advantage of the assistance of an experienced photometrist, who recorded the results of the various experiments, and who was always able to note the changes in the behavior of the standards that were observed by the author.

As a result of this inquiry, the author concludes: That gas cannot be substituted in these standards as the equivalent of air as a carrier of the pentane vapor. That the light from the standards is seriously affected by variations in the height of the flame; a low flame being more prejudicial than a high one. That the light is seriously affected when the temperature of the carbureter approaches 90° F. That the light varies with the sides of the photometer.

Experimental Methods.

In making determinations at various rates of gas consumption, it is important to bear in mind that, though a photometer may deliver a definite quantity of gas for one complete revolution of the meter wheel and for one complete revolution of the pointer, yet for fractional parts of a revolution it may not be safe to accept as correct those marked upon the dial; and to avoid the inconvenience of calibrating this, the following method was adopted: The rate is observed by noting the time required for one or more complete revolutions of the meter hand from point to point. The candles' light observed multiplied by the time in minutes for one complete revolution gives the candles per 5 cubic feet. A meter wheel does not deliver gas at a uniform speed at different parts of its revolution. To correct this inequality it is necessary to adjust the photometer governor so that it is nearly closed, and to increase the gas pressure in the inlet of the meter, if necessary, to enable the governor to pass the required quantity of gas.

In making a series of experiments on a sample of gas as regards the light it yields per unit volume at various rates of consumption, it is requisite that it shall be of constant quality throughout the series. To insure this uniformity, the samples were collected in small gasholders of 5 or 10 cubic feet capacity; and it was easy to ascertain that the gas had remained constant by repeating at the end of the series, or at any interval, experiments at the same flame value. In no case was any variation observed unless the gas had been carbureted in the laboratory on the inlet of the small gasholder; and then stratification was invariably observed. To remedy this difficulty it was necessary to churn such samples by drawing the gas off from the top of the gasholder, and passing it in again at the inlet. Without this precaution the experiments would have been illusory.

In the experiments made on various gases, they were compared on the basis of flame values by measuring the quantity of gas required to maintain them. The light yielded per unit volume at a 16 candle flame value is taken as 100, and that at other flame values in terms of 100. Thus, if a gas, when burned to give a flame of 16 candles, gave a duty of 2.8 candles per cubic foot, and at a flame value of 10 candles gave but 2.1 candles per cubic foot, it would be said, as regards burner efficiency at the 16-candle flame, to be 100, and at the 10-candle flame to be 75. The yield of light at the 16-candle flame is taken as par.

Table of Burner Efficiencies.

Candle Power of the Gas per 5 Cu. Ft. Calculated from the Yield of Light per Cu. Ft. when Tested at the 16-Can. Flame Value.	Flame Values in Candles. (In no case were the flames smoking.)								
	10	11	12	13	14	15	16	17	18
(1) 10.80	...	...	...	...	...	95.0	100	105.0	107.5
(2) 11.05	...	...	...	...	92.4	....	100	.....	.....
(3) 11.30	75.7	....	83.9	....	92.9	....	100	.....	106.6
(4) 12.53	....	....	...	...	...	97.0	100	100.8	103.4
(5) 13.43	77.6	....	...	...	93.3	....	100	102.0	.....
(6) 13.60	78.9	....	....	..	....	....	100	.. ....	.....
(7) 14.08	74.5	....	....	...	94.4	97.7	100	101.9	104.8
(8) 14.08	....	....	....	..	....	97.5	100	100.2	101.2
(8*a*) 14.24	78.7	....	....	....	.. .	97.1	100	.....	.....
(9) 14.30	80 0	....	....	...	95.1	97.2	100	100.3	102.1
(10) 14.49	78.9	....	87 6	....	....	97.9	100	100.3	101.2
(11) 15.40	78.1	....	...	90.4	94.8	97.4	100	101.6	101.6
(12) 15.69	....	....	...	...	94.8	96.8	100	102.9	100.0
(13)*	79.8	83.4	86.9	90.3	93.6	96.8	100	102.8	.....
(14) 16.90†	85.8	.. .	....	....	.....	99.7	100	95.9	.....
(15) 16.10†	75.8	....	....	....	....	102.3	100	.....	.....
(16) 16.40‡	83.3	..	....	....	.....	98.6	100	100.8 (at 17.4 c.)	96.9
(17) 18.73‡	85.3	....	....	....	98.9	101.9	100	98.6 (at 16.4 c.)	.....
(18) 22.00§	85.2	87.5	89.4	94.4	97.5	99.2	100	95.8 (at 16.75 c.)	.....
(19) 32.00‖	93.0	...	99.5	....	104.0	102.7	100	.....	.....

* Average of 16-candle coal gas, tested with candles.
† Coal gas enriched with benzol (C_6H_6).
‡ Coal gas enriched with gasoline.
§ Coal gas and cannel gas mixed.
‖ Cannel gas.

The candle power per 5 cubic feet in the above table is not the candle power if the gas had been tested at that rate, but what it would have been if at that rate it had yielded the same light per unit volume as when tested at the 16-candle flame value. Had the candle power of the gas been stated at the yield at the 5 cubic feet rate, the lower qualities would of course have been very much less.

It will be observed that the loss of light per unit volume between the 16 and 10-candle flame values increases, though not in a perfectly regular manner, with the poorness of the gas. With coal gas up to nearly 18-candle power, the author had not noticed any case wherein the efficiency at the 15-candle flame value was higher than at the 16-candle flame value; and the case of the 16.1-candle coal gas enriched with benzol (No. 15 in the table) struck his attention. The photometric experiments were repeated many times; and in every case it was found to be so. In the case of coal gas enriched up to 18.73 candles (No. 17), the same effect was noticed. It was not so, however, in the case of the 22-candle coal and cannel gas (No. 18).

Smoking Point.

According to Mr. Patterson's maxim, the maximum efficiency per unit volume is, in Argands, at the point when any further gas supply would produce smoke. At this point the following flame values were obtained:

Candle Power per 5 Cu. Ft. Calculated from the Yield per Unit Volume Found at the 16-Candle Flame Value.	Flame Value. Candles.
11.30	18.00
11.53	16.00
14.05	17.80
14.00	18.00
14.30	18.00
15 40	18.60
16.50	17.00
16.56 enriched with benzol	18.00
16.92 " "	17.00
17.16 " "	17.00 (bare)
18.73 " gasoline	16.40
22.00 coal and cannel gas mixed	16.75
32.00 cannel gas	16.11

The case of the 11.53-candle gas was curious, as the chimney had to be literally filled with flame before it commenced to smoke; and the flame value was only 16 candles.

This method of finding the point of maximum efficiency would have failed as regards the gases cited in the table of efficiencies in all cases from Nos. 13 to 19 inclusive; but these are cases of either rich gases or gases enriched with benzol or gasoline. The 32-candle cannel gas did not give the slightest signs of smoke at the 16-candle flame value. It was increased to a flame value of 16.11 candles before a tendency to smoke was observed; and yet the maximum efficiency was found at the 14 candle flame value. Mr. Patterson's rule is not contradicted by any of the samples in the table of efficiencies from Nos. 1 to 13 inclusive.

Coal gas, with its various enriching bodies, is a complex material, and when one considers how delicate are the relations between the air and gas supply in the Argand burner, it is difficult to hope that any rule of universal application will be found to apply to all its varieties. To prescribe for official testing that the flame shall be adjusted just short of the smoking point, or that the chimney shall be full of gas (even if such prescriptions could be made sufficiently definite to be safely applied for the purposes of official gas testing), would, it is believed by the author, in some cases be prejudicial to the gas.

As regards testing gas for official purposes at a defined flame value, that is only practicable if an invariable standard of comparison can be produced under all the conditions likely to arise in practice; and the author is of opinion that, before the Dibdin 10-candle standard can be adopted as providing that invariability, further experience is requisite. It must also not be forgotten that many gases will provide in the "London" Argand the same flame value at two different rates of consumption.

Mr. Wright added that, since his paper had been prepared, he had had opportunities of making experiments with other standards. In the paper he had hardly cared to hazard an explanation of the results; but he might say, not as the result of any experiments actually made which definitely proved the matter, but as a hypothesis which was not contradicted by anything observed, that one standard would not behave in the same manner in two different places. This was a fact which he had observed on many different occasions, and it must be accepted as a fact. He believed the reason was that Argand flames were exceedingly sensitive to exterior air currents. The least disturbance in the air supply would cause the flame to rise above the mark at which it was adjusted, and even to flare in the chimney. He could quite believe that the standard might behave in a particular manner in a position where there were air currents of a certain velocity, and that, on being removed to another site, where the currents might be only feeble, and where the chimney would be supplied with loose air, and where consequently, for the same amount of combustible material going into the chimney, there would not be sufficient air for the flame, it would behave differently. It would then be necessary to reduce the amount of combustible material by adjustment of the micrometer cock. Then if the height of the flame were reduced, and at the same time the amount of the combustible material, how was it possible to have the same intensity of flame value? He believed this would be found to be the explanation of the abnormality in the behavior of these standards.

Compressed Air in the Foundry.

[A paper read by Mr. Curtis M. Shields before the Foundrymens' National Convention.]

Since compressed air is now produced economically, owing to the many recent improvements made in the design and construction of compressing machinery, the up-to date plant without its air compressor in the power house is the exception. In the latest and most approved types of compressors the mechanical efficiency has been found under actual working conditions to be as high as 95 per cent., while an efficiency of 85 per cent. or better is to be obtained in a small compressor suitable for any moderate foundry duty. In order to get the best results from the machines using compressed air it is of the greatest importance that the air supply shall be constant and ample. To insure this beyond peradventure the compressor must be substantially constructed on the designs shown by the severe test of experience to give the best results. The durability of an air compressor depends largely upon the design of the air parts. As the valves are the most essential feature of an air compressor, it is clear that in order to insure the proper and efficient working of the whole machine the valves must work properly and effectively at all times, and under all conditions. The poppet valve is, perhaps, the most common type employed in air compressor construction, and is used for both inlet and discharge. Inlet valves of this class are very apt to cause endless trouble, particularly when they are located in the cylinder heads, as a broken stem or a loose nut permits the valve, or part of it, to drop into the cylinder. This danger may be obviated to some extent by placing a guard plate on the inside of the cylinder head. This remedy has the objection that it increases the space lost for clearance and slightly restricts the passage of air into the cylinder. In the most approved style of compressor, poppet valves are located in the ends of the cylinder instead of in the heads, and are so placed that they have a vertical instead of a horizontal lift. This arrangement assures an even wear on the valve and its seat and prevents leakage. It also prevents the piston from coming in contact with the valves, and in case of a break the valve cannot be sucked into the cylinder. This disposition of the inlet valves leaves the entire cylinder head free to be fitted with a water jacket or cooling space. It is not practicable to make poppet valves of any great diameter, hence when a large machine is built it is necessary to use a number of valves. This divides the air entering the cylinder into several small streams which pass over heated surfaces, thereby increasing the friction of the air entering the cylinder and decreasing the capacity of the compressor.

By removing the inlet valves from the cylinder head a large cooling surface, equal to about three fourths of its area, is at once made available. This is more valuable for cooling than the cylinder jacket alone, because the air is hottest after the piston passes the center of the cylinder; hence we have the hot air pressed against the cold cylinder head, where it rapidly gives up its heat.

Many of the difficulties and disadvantages have been successfully overcome by the piston inlet valve. This device comprises a hollow tail rod passing through a stuffing box in the back cylinder head, a hollow piston into which the air is admitted through the tail road and a ring valve of T-section on each side of the hollow air piston head. These valves allow the air to pass alternately into each end of the cylinder, and are actuated by means of their own inertia, opening or closing at the moment compression ceases or begins. By means of the piston inlet device a concentrated air inlet current is secured. A suitable sleeve or conduit pipe may be made to conduct to the tail rod inlet air drawn from that source outside of the engine room most favorable to coolness, dryness and freedom from dust or other foreign matter.

Where the load on the compressor varies much it is important that an efficient regulator or governor should be provided which is thoroughly automatic in its action and requiring no attendance.

Under the ordinary conditions existing in foundries a belt driven compressor is usually more favorably considered than one driven by steam. A belt compressor fitted with a proper regulator absorbs only enough power to meet the demands of the work performed, and being run in connection with other machinery its effect on the coal consumption is not noticeable.

However, in many cases a steam driven compressor is preferable, because a high class steam actuated compressor uses steam almost if not quite as economically as a shop engine, and whatever loss there may be is more than made up for by the advantages of a steam driven compressor. With them all shafting and belting are avoided, and the machine can be located in the engine room, where it can be under the care of the engineer. If installed in the foundry the dust and sand have a very appreciable effect upon the bearings and moving parts, and no matter how carefully housed, your compressor cannot be as well taken care of as though it were in the engine room.

Transmission of power by compressed air has the advantage of certainity and regularity in action, simplicity in machinery, freedom from the possibility of fatal accidents, and the assistance given to ventilation and in cooling the shop.

When we come to the question of laying out the piping for a foundry it is well to keep this simple rule in mind. The head necessary to drive the air through the pipe is as the square of the velocity, and to obtain the best results the flow of air through the pipe should not exceed 20 feet per second. If this is borne in mind air can be conveyed almost any distance with little or no loss. In the case of the famous Jeddo tunnel, at Hazleton, Pa, air at 60 pounds pressure was conveyed a distance of 10,680 feet through 5½-inch pipe, and the gauges showed exactly the same pressure at the end of the pipe as they did at the receiver.

The receiver should be placed in any convenient place and should be of no less capacity than the rating of the compressor in cubic feet of free air per minute. A little thought and attention given to the elimination of turns and angles in the pipe mains will amply repay for the trouble. It is a great economy to lead the air mains centrally

and then run small connections to points adjacent and convenient to place air is to be used. If this is done short lengths of hose pipe can be attached wherever most convenient for connection to hoists, sand sifter or other apparatus, or the air can be used for the same purposes that the bellows and brush are employed for.

The application of the air hoist to cranes may be made in an almost endless variety of ways to meet the requirements of foundries. The most common types are simple cylinder hoists, either vertical or horizontal, or in combination with a low pressure hydraulic system. In many instances direct acting hoists may be readily applied to hand power cranes already in use without in the least interfering with the gearing and at a very small expense.

There is no noise, no jar, and the load is always balanced. In foundries where an overhead traveler cannot be installed air hoists suspended from trolleys running on an overhead track answer very satisfactorily, and if hose couplings similar to those used in connection with the ordinary air brake are provided, by simply attaching the hose connection after the load is raised the hoist may be run on the overhead track to any desired part of the establishment. This is especially valuable in conveying flasks outside of the foundry to storage sheds, patterns to the pattern shop, or finished castings to the machine shop.

Few of us realize how cheap an air shaft is to operate apart from its convenience and speed in handling loads. It has been estimated by Frank Richards that at 100 pounds gauge pressure compressed air costs 5 cents per 1000 cubic feet of free air.

The following table gives the lifting capacities of direct acting air hoists, with volume of free air per lift, and cost of air per single lift and per 100 lifts, with a maximum lift of 4 feet, and a minimum pressure of 90 pounds, air furnished at 5 cents per 1000 cubic feet of free air.

Diameter of Cylinder.	Effective Area of Piston.	Maximum Weight Lifted.	Cubic Ft. free Air for 4 Feet of Lift.	Cost of Air per Lift.	Cost of Air per 100 Lifts.
2	3.05	274	0.74	$0.000037	$0.0037
3	6.87	618	1.67	0.000084	.0084
4	12.22	1,099	2.97	.000149	.0149
5	19.09	1,718	4.64	.000232	.0232
6	27.49	2,474	6.68	.000334	.0334
7	37.42	3,367	9.09	.000455	.0455
8	48.87	4,398	11.88	.000594	.0594
9	61.85	5,566	15.03	.000752	.0752
10	76.36	6,872	18.56	.000928	.0928
11	92.39	8,315	22.46	.001123	.1123
12	109.96	9,896	26.73	.001337	.1337

Air used in combination with a low pressure hydraulic system gives the best results for heavy loads. By interposing the water between the elastic medium, air, and the load we eliminate that element of danger which otherwise would be present in handling vessels of molten metal, as in foundry practice, and also obtain a sort of elastic positiveness which is so essential and desirable. In the actual work of molding, as in lifting copes and molds, drawing patterns and moving cores, the men are enabled to do about 50 per cent. more work, and do it easier and better, when equipped with a hydro-pneumatic hoist. Included in this percentage is the saving in repairs and the danger of losing castings.

In addition to operating movable hoists, air has proven its value for conveying pig iron to the top of the cupola, and for breaking up scrap by lifting a heavy weight, which is dropped some 15 or 18 feet. This pig breaker broke three half pigs into three pieces each in one minute, and can easily break 20 tons of pig while a man is breaking up 1 ton by the old sledge method. A portable pneumatic drilling machine for boring holes to weaken stiff castings is used to advantage in connection with this breaker.

The product of a molding machine can be greatly increased if the handling of the sand in shovels is done away with. This is accomplished by an air jet, which at 60 pounds pressure will lift 100 pounds of sand per minute 20 feet high. A ¼-inch nozzle will use 90 cubic feet of free air per minute doing this duty. By elevating the sand to a bin overhead and then conveying it in a chute or pipe directly over the molding machine much time and labor can be saved. A simple slide in the pipe forms a ready means of regulating the amount of sand served to the machine for each mold. In the portable pneumatic sand sifter a small amount of air operates a rotary motor which drives gearing connected to the sieve. Air admitted through a ¼-inch opening at a pressure of 70 pounds develops sufficient power to do the heaviest work.

Recent observation of a molding machine in operation at the foundry of the Ingersoll Sergeant Drill Company, of Easton, Pa., gave the following figures: On rock drill cylinders, three helpers, operating a duplex machine, can turn out 22 per day. It formerly took four molders to make this output. In other words, to do the work by hand now being turned out with the aid of the molding machine operated by compressed air would cost 100 per cent. more than is being paid now. On rock drill steam chests the same machine operated by two helpers produces 66 molds per day. Formerly it required three molders to equal this number. In this case it would cost 125 per cent. more to turn out same product by old method.

The economy of the sand blast for cleaning castings was quite as marked as that of the molding machine. On a flask 30 x 14 x 5 inches, made without using any facing, no difficulty was experienced in cleaning 6 square feet of surface per minute. A box bedplate weighing 1,700 pounds was cleaned in one hour by the blast, while another bedplate made from same pattern took three hours to clean by hand. With the blast the casting was cleaned so that the chipper did not have to do any cleaning as he had to do when blast was not used. Neither brushes nor files will get around fins and risers as the blast does. A very difficult casting with cores that are almost impossible to get out by hand was cleaned in 45 minutes by the blast, as against 2 hours and 40 minutes by hand.

In this same foundry they formerly melted about 5 tons of iron per day and employed 14 molders, 8 core makers, and a cleaning and chipping gang of 7. They have practically doubled their plant, and now pour 10 to 12 tons per day and employ 27 molders, 12 core makers and a number of labor-saving devices to increase their output, but the same cleaning gang of seven men, with the addition of a sand blast, take care of the product, and the cleaning is done in a much better manner than previously. The sand blast not only effects a great saving in the actual cost of the castings, but a further saving through the removal of the oxide which is so destructive to tools in the machine shop. This saving on tools is most apparent where the work is milled, as cutters can be run at an increased speed. The sand blast applied to the tumbling barrel is an improvement worthy of notice. Aside from the economical features connected with the use of the sand blast, it cleans the castings far better than by hand, and where a casting has intricate steam or air passages it is of the greatest importance to be able to thoroughly clean these inaccessible parts.

Associated with the sand blast, the pneumatic chipper shows to good advantage. These tools were formerly too delicate and complicated for foundry uses, but recent improvements have so simplified their construction that they now have only three pieces in their entire makeup, and but one of these is a moving part.

Dark foundries have found the Wells, Lucigen or some similar light of great use where a cheap intermittent light was needed. In these lamps compressed air forces oil through a nozzle, forming a spray, which when ignited gives a flame about 5 inches in diameter and 30 inches long, and of about 1,000-candle power. The air is used at a pressure of from 10 to 30 pounds, and 1 gallon of oil and 60 cubic feet of free air per hour suffice to operate the lamp. These hydrocarbon burners are very useful for skin drying large molds, as well as for lighting.

Breaking test bars from each cast is another use to which air has been applied.

A comparatively small air compressor of proper construction and design will furnish sufficient air for all the needs of a foundry of ordinary size. An illustration in point is a foundry running four cranes of 20, 10, 8 and 1 ton capacity, respectively; a sand blast, two pneumatic chippers, 1 duplex molding machine and for blowing out and dusting molds in process of construction. In addition the machine shop uses air for testing small engines and blowing out cylinder ports and inaccessible parts after machining to get rid of oil and chips and for bench dusting and copying letters in the office. Air at 60 pounds pressure for all these uses was supplied by a 14 x 16 x 18 compressor running at 120 revolutions per minute and furnishing about 500 cubic feet of free air per minute.

Boiler Room Economics.

Mr. T. W. Yardley, of Messrs. Robert W. Hunt & Co., of Chicago, read the following paper, on "Boiler Room Economics," before the American Water Works Association, at the meeting of that body held in Indianapolis, Ind., May 26th:

During the past four years we have found that a great saving can be made in the fuel bills of many pumping stations and power plants. In fact, it is seldom that a station is a model in every respect.

When most boiler blants are planned and built the particular kind of

coal to be used is not considered. Then the best coal for that particular furnace or setting is found, but it seldom happens that this will give the cheapest steam. When Eastern energy and capital came West of the Allegheny Mountains it brought with it a relic of the past called "the plain grate," which is all right in its place; but it has absolutely no place except where anthracite coal is used. It is simply throwing money away to try to burn a coal containing 35 per cent. volatile matter on a grate which is adapted to a coal having only 10 per cent., and hence not requiring nearly so much air to complete combustion. In most localities there is some particular coal which can be obtained at less cost per ton than any other, but this coal is rarely used, as the engineers will say it is not adapted to their plant.

An average of some 40 samples of Illinois coal recently analyzed in our laboratory gives the following approximate compound: Fixed carbon, 41.52 per cent.; volatile matter, 41.33 per cent.; ash, 12.94 per cent.; moisture, 4.21 per cent. The carbon yields about 14,500 heat units, while the volatile matter gives 20,500 heat units per pound. When this highly volatile coal is thrown into a hot furnace suddenly, the gases are immediately distilled and pass off without combining with sufficient fresh air to complete combustion. When they strike the comparatively cold boiler tubes a heavy black smoke is produced. Could this coal have been fed into the furnace slowly and continuously, thus allowing the gases to pass off slowly as the coal is coked, a much higher temperature in the furnace, a clear stack and a great increase in the efficiency of the boiler and furnace would be obtained.

To substantiate this assertion I give a summary of a series of trials made to determine what furnace was the best adapted to the economical burning of a highly volatile coal from Ohio. The coal in the different trials was from different localities of the same vein. The boiler was a first-class make of water tube style, and the setting alone was varied. The tests were each of 10 hours' duration and made under ordinary running conditions.

No. 1. Arch furnace and plain grates.
No. 2. Arch furnace and shaking grates.
No. 3. Arch furnace and rolling grates.
No. 4. Down draft furnace. Capacity test.
No. 5. Down draft furnace. Economy test.

	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.
Heating surface.....	2,580	2,580	2,580	2,580	2,580
Grate surface.....	42	42	49	35.5	35.5
Escaping gases.....	644°	530°	669°	483°	431°
Evaporation per lb. coal from and at 212°... ..	7.34	7.92	7.87	8.79	9.10
*Efficiency.....per ct.	58.3.	62.4	61.9	69.4	71 9

*Efficiency was calculated from the total B.T.U. and the heat absorbed by the water.

The analysis of the coal was: Moisture, 1 00; volatile matter, 39.54; fixed carbon, 47.00; ash, 12.46; British thermal units (by calorimeter), 12,100.

A down draft furnace was chosen for this coal because of the possibility of admitting any required amount of hot, fresh air.

Speaking of smokeless furnaces and mechanical stokers, I do not doubt that each one of you has been bothered with representatives claiming and guaranteeing increased economy and capacity over every other make, but it is as preposterous for them to claim superior results with the same furnace on all grades and kinds of coal as it is for us to try and burn soft coal economically on the plain grate. There are few of the many patent furnaces which have not some good points, and each one has been developed for some certain grade of coal; but we have not yet found one whose owner has studied the subject sufficiently to know just what coal his furnace can burn most economically and tell the reason why.

Two large boiler companies have recently carried on long series of tests on different Western coals, with plain grates, and it is only a question of time when both boiler and furnace companies will know just what different results will be obtained with different combinations and with different coals. A large Western water works plant recently let a contract for the construction of boilers and furnaces under a certain guaranteed efficiency, using Pocahontas coal for the tests. The furnace and setting will be constructed to obtain the best results from this high grade high priced coal, but it is a question whether the same settings will give the best results with a cheaper coal which can be obtained at that point, and from which steam can be generated for at least 15 per cent. less money. Had the situation been carefully studied and the best coal decided upon, and the test been made on that coal, the possibility of mistakes would have been avoided, for the best furnace for one may not be the best for another coal.

The engineering profession have developed the pumping engine to a very high point of perfection, and the boiler has also received its share of attention; but not until the past few years has attention been paid to the most vital question of getting all the good that there is in a fuel. In many cases this subject has been taken up by cranks and uneducated inventors, and their work has resulted in many good furnaces, but this subject sadly needs the fundamental rules of design to perfect it.

Bueb's Method of Preventing the Freezing of Gas Pipes.

On May 12th U. S. Letters Patent (No. 559,992) were granted to Mr. Julius Bueb, of Dessau, Germany, for a method of preventing the stoppage of gas conduits from deposits caused by frost. Using the words of the specification:

An extremely troublesome disturbance in gas lighting, in particular in street lighting, consists in the stopping of the conduits produced in very frosty weather by the freezing of certain deposits out of the gas, which assume the form of fine ice needles, and which narrow or close the clear cross-section of the gas pipes. One of the oldest means for converting these hoar frost like deposits formed in the interior of gas pipes into a liquid condition consists in the use of ordinary spirit. By means of this substance conduits leading, say, to street lamps, are thawed, the burners being for this purpose screwed off and spirit poured into the conduit, which in flowing downward dissolves the frozen material and leads it to the next water-pocket. This method of remedying freezing (but not preventing it) is tedious, expensive, is only of temporary efficacy, and requires much time. Efforts to find out an efficacious preservative against freezing have, therefore, been made long ago. Already, 60 years ago, attempts have been made in England, and in 1844 James Malam proposed (English Patent No. 10,326, 1844) to prevent the separation of condensates within the conduit network by submitting the whole quantity of gas to be delivered to the action of frost, while still in the gas works, in large and, if necessary, artificially cooled condensing vessels, called by him "freezing cylinders," exposed freely to the external temperature. This method, based on the supposition that water coming from the manufacture and contained in the gas in the form of vapor was the sole cause of the freezing of the conduits, is not applicable in practice, and has, indeed, never been used, though latterly it has been proposed anew, although if correctly carried out the final purpose—namely, to prevent freezing in the pipe network—may be attained. The fundamental idea contained in this method—namely, to extract from the lighting gas already in the gas works the condensable constituents—is found again in different form in several methods, the authors of which also considered as the cause of the freezing the water contained in the gas and attempted to free the gas from water by using water absorbing chemical agents. There have been proposed and used as drying means of such a kind spirits (method of J. Malam), chloride of calcium, (method of Dabrowski) sulphuric acid—the latter, for instance, in the German Letters Patent, No. 77,530. All of these methods are of no practical utility, though in part, at least, they are quite appropriate for preventing freezing.

In carrying out practically on a large scale the method described in the German Letters Patent No. 77,530, it has been proved that the opinion that the water contained in the gas is alone the cause of the freezing up of the gas conduits is wrong, as in a severe frost not only water but also benzol is crystallized on the cold walls of the pipes. As in the method of desiccating by freezing cylinders, as well as in the drying of the gas by means of spirits, benzol is also separated unintentionally. Besides water these methods are no doubt appropriate for preventing the closing of the gas pipes by freezing, but this is effected at the expense of the illuminating power of the gas, benzol being a main light producer of the gas. The illuminating power, which for the most part is brought to the prescribed degree only by gasifying expensive additional coals or by carbureting with benzol or similar substances, is controlled by the authorities and the public so strictly that a method like that of Malam, where the gas, owing to the contact with liquid spirit in a large area, loses so much benzol (more than ten grams per cubic meter, as shown by experience) that the illuminating power decreased about 38 per cent., is, in spite of its efficaciousness, industrially not applicable. On the other hand, the separation of water alone, as it is obtained in the process described in the German Letters Patent No. 77,530, or in the method using chloride of calcium, is not sufficient to prevent the stopping of the gas pipes by freezing in a strong frost. Thus all the methods hitherto proposed or tried having for their final purpose to prevent the closing of the gas pipes by frost

by separating from the gas while in the gas works the condensable constituents, or drying processes, are either inefficacious, or, when they are efficacious, they are inapplicable, owing to the decrease of the illuminating power of the gas.

According to my present invention I propose to attain the intended purpose, not by withdrawing from the gas any component part, as heretofore attempted, but by adding a substance that shall have the effect of lowering the freezing point of the condensable constituents to such an extent that they precipitate only in a liquid condition. As a suitable means for this purpose ordinary spirit has proved advantageous. It is added to the gas either at the place of the gas production, preferably behind the gasholder, or at any other point of the pipe network, and in order to avoid any decrease of the illuminating or heating value of the gas the spirit is added in the form of vapor. This is necessary because, although liquid spirit would be absorbed in part by the gas within the gas conduit, yet, on the other hand, the liquid would absorb benzol from the gas. Moreover, by adding the spirit vapor produced outside the gas conduit the quantity of the introduced spirit vapor can always be exactly regulated corresponding to the quantity of gas produced and to the external temperature, while, when liquid spirit is introduced into the gas conduit, the gas passing through takes up a larger quantity of spirit vapor, the lower is the quantity of gas delivered at the moment and the higher is the external temperature. It is necessary that the addition of the spirit vapor is capable of regulation, as on the one hand there must always be so large a quantity of spirit in the gas that the intended effect is attained, and on the other hand only so much must be added as will remain in the gas in the form of vapor. An appropriate quantity is five grams of spirit vapor per cubic meter of gas delivered. In the case of particularly severe frosts a little more may be used.

In practically carrying out the method a small evaporator of ordinary construction, heated by a steam-jacket or by small gas burners, is used, into which the spirit enters from a reservoir arranged at a higher level through a regulating valve in a fine jet, which is immediately evaporated. The hot spirit vapor is introduced through a small tube into the main and absorbed by the gas. The illuminating and heating value of the gas is not prejudicially influenced by the small quantity of spirit vapor. The desired effect of the added spirit vapor only takes place in that portion of the gas supply which is exposed to the action of the frost. The other (ordinarily much larger) portion of the gas is burned without the spirit contained therein exercising any effect. This is a great advantage of the new method in comparison with the drying by means of spirit. In the latter method the whole quantity of gas to be delivered is submitted already in the gas works to the action of the alcohol, absorbing not only the water, but benzol, and thereby reducing the illuminating power. This is entirely unnecessary, as it is always only a small portion of the gas that passes to such places of the conduit (in particular, street lamps) which are exposed to frost. When applied according to my invention, on the contrary, the spirit enters into action only where the gas is acted upon by frost and at the place where such action takes place in separating from the gas, together with the water and benzol, and thus preventing the latter from congealing, and consequently the conduits from being stopped by freezing.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is—

The herein described method for preventing freezing of gas pipes, without reducing the illuminating or heating power of the gas, consisting in introducing into the main, while the gas is flowing, exactly measured and regulable quantities of spirit vapor, adapted to lower the freezing point of the condensable constituents for preventing their deposition in solid form.

Ruins of the East St. Louis (Ills.) Gas Works, as Photographed May 28th, 1896.

Wreck of the East St. Louis (Ills.) Gas Works.

The accompanying illustration plainly shows the condition of the East St. Louis Gas Works, at East St. Louis, Ills., after the passing of the terrible storm of May 27, which caused such great loss of life and property in the districts swept by it.

The plant of the East St. Louis gas proprietors was literally torn to pieces. A holder (60 feet by 20 feet) was lifted right out of the tank, one half of the vessel, together with two large columns and three girders, falling on the retort house roof. The other half was wrapped around the retort house, in blanket fashion. Mr. Henry Maguire, Superintendent of the Company, however, immediately instituted the work of reconstruction, and the Kerr Murray Manufacturing Company are now getting out the material for a new holder and roofs for the buildings. Supt. Maguire is confident that the gas supply to the city will be renewed by July 1st. The damages sustained are put at $15,000, which sum, however, does not include any allowance for loss of business during the month of June.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

THE proprietors of the Los Angeles Lighting Company, of Los Angeles, Cal., have announced that, on and after July 1st, the gas rate will rule at $1.75 per 1,000 cubic feet.

AT the annual meeting of the shareholders of the Camden (N. J.) Gas Light Company the following Directors were elected: B. F. Archer, Charles Watson, R. S. Smith, Samuel A. Cooper and John McIlhenny. The Directors subsequently perfected the following executive organization: President, B. F. Archer; Secretary and Treasurer, Charles Watson.

THE headquarters of the Eastern agency of Messrs. George M. Clark & Co., of Chicago, have been removed to 284 and 286 Pearl street, from 152 and 154 West 23d street, this city.

MR. JOHN W. WHELAN, formerly City Treasurer of Elizabeth, N.J., has been elected Chairman of the Executive Committee of the Board of Directors of the Perth Amboy (N. J.) Gas Light Company.

AT a recent meeting of the City Council of Atlanta, Ga., one of the matters under consideration was the report of the special committee charged some time ago with the duty of determining whether or not it would be for the benefit of the city to create the office of Gas Inspector. The report favored, in half-hearted fashion, the maintaining of such an official, and an ordinance providing for the establishment and keeping up of the berth was also submitted. After an extended discussion, a motion to accept the ordinance was defeated by a vote of 7 to 5.

WE regret to announce the death of Mary Dawson Snyder, the estimable wife of Mr. R. M. Snyder, President of the Missouri Gas Company, of Kansas City, Mo. Deceased, who was in her 36th year, was a native of Plattsburg, Mo.

THE latest achievement of that wideawake business man, Col. Frank S. Richardson, the moving genius of the North Adams (Mass.) Gas Light Company, is to convince the management of the Fitchburg Railroad Company that it would be economy on their part to take the current necessary for the lighting of the Hoosac tunnel from the Gas Company's electric lighting annex—the Railroad folks have hitherto generated the current for this illumination from a plant maintained by them at the "West Portal" of the tunnel. The lighting of the tunnel requires 1,250 incandescent lamps of 16-candle power each, and the Gas Company, in order to maintain the service, will replace an existing 250-horse engine with a 400-horse—this will give the Company two 400-horse engines. The boiler capacity will also be sensibly increased. The lamps are kept in service, of course, day and night.

THE Atlanta (Ga.) Gas Light Company has gone into its handsomely equipped and commodious new office quarters, in the building formerly occupied by the Atlanta Home Insurance Company, corner of Broad and Alabama streets.

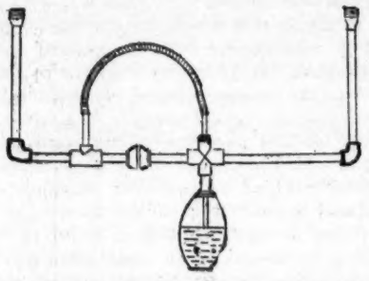
THE Paris (Ky.) Gas Company's plant was damaged by fire a few days ago. The loss is put at $1,000, and is fully covered by insurance.

THE proprietors of the Yonkers (N. Y.) Gas Light Company have informed Mayor Peene, of that city, that on and after July 1st the following net rates for gas shall rule: For gas used on illuminating account, $1.40 per 1,000 cubic feet; for use on fuel account, $1.25 per 1,000.

THE official Gas Inspector for Minneapolis (Mr. Meeds) reports that the quality of the gas furnished the city during May was satisfactory. The candle power (average of 26 tests) was 26.08; and the average consumption of gas in the public lamps (average of 100 tests on as many burners) was 5.93 cubic feet per hour. The average maximum pressure was 2.57 inches; average minimum, 1.74 inches. Only one service meter was tested, and it was condemned, the test having shown that it was 5 per cent. fast.

MR. E. C. MORE, of St. Louis, and Mr. J. Eimer, of Belleville, Ills., have been elected Directors in the Peoria (Ills.) Gas Light and Coke Company, vice Messrs. Peter Coffey and M. Griswold, deceased.

MR. JAMES FERRIER, Superintendent of The Gas Light Company, of Columbus, Ga., writing to us under date of May 28th, incloses a corrected sketch of his contribution to the Wrinkle Department, at the last meeting of the Western Gas Association. The wrinkle bears the caption, "Improved form of delicate test for piping," and is an adaptation by Mr. Ferrier of the device explained by Mr. B. E. Chollar in the Western's wrinkle collection for 1895. The amended sketch, which is



given herewith, is intended to replace Fig. 18, Plate V., as the same appears in our report of the proceedings of the Western meeting, issue for June 1st.

THE American Gas Company has declared its usual semi-annual dividend of 3 per cent. Checks were mailed on the 1st inst.

THE following letter corrects to completion our reference last week to the doings of the itinerant meter inspectors at Gloucester, Mass.:

GLOUCESTER GAS LIGHT COMPANY,
GLOUCESTER, MASS., June 8, 1896.

To the Editor AMERICAN GAS LIGHT JOURNAL: Your report of the inspection of the meters of our Company by the State Inspector is not exactly correct. His report was that seven registered correctly. One was 2½ per cent. fast, or ½ of 1 per cent. more than the law allows against the consumer; while one registered 6 per cent. slow, or 4 per cent. more than the law allows against the Company. Please correct your item in next issue to correspond with this, as we consider it a complete vindication of the claim that we made at the time that our meters were correct. Yours very truly, J. A. COFFIN, Supt. Gloucester Gas Light Company.

MR. ADAM WEBER, proprietor of the Manhattan Firebrick and Enameled Clay Retort Works, recently entertained a distinguished party of gas engineers at the Weber manufacturing plant, Weber, N. J. After the handsome and well equipped plant had been inspected, Mr. Weber escorted the visitors to the "Kathryn Inn," where a substantial luncheon was enjoyed. The Superintendent of the Weber works (Mr. Charles C. Schmitt) shared with proprietor Weber the congratulations of the visitors over the completeness of the plant, which lacks nothing required to turn out a large product in short time.

ACCORDING to the *Journal für Gasbeleuchtung*, M. Mare, of Paris, France, has constructed an incandescent or glow light burner, quite similar to the Fahnehjelm. It is intended for inside illumination, mainly, and shows a construction on Fahnehjelm's lines. The glow body is made of threads of silk, or other suitable threads, which are soaked in a solution of 1 part of sulphate of magnesium, 2 parts of sulphate of erbium, 2 parts of zirconium and 25 parts of water. Nitrates may be employed instead of sulphates. The threads are first fastened to a platinum wire, then dipped into the solution and dried at a temperature of 60° C. After the threads are saturated and dried they may be coated with collodion varnish to fit them for transport. No data are given to show the durability or efficiency of these burners.

ACCORDING to the Boston *Herald* the output of the plants included in the system of the Bay State Company in and around Boston for the periods named were:

	May, 1896.	May, 1895.	Increase.
Boston Co..	78,135,000 cu. ft.	74,310,000 cu. ft.	3,825,000 cu. ft.
Roxbury...	15,057,000 "	13,077,000 "	1,980,000 "
Dorchester.	11,573,000 "	7,580,000 "	3,993,000 "
S. Boston...	7,488,000 "	7,586,000 "	2,002,000 "
Total.....	112,253,000 "	100,453,000 "	11,800,000 "
Since Jan. 1	743,299,000 "	654,885,000 "	88,414,000 "

THE Chicago *Dispatch* is responsible for the following: "'This here new light of Edison's would be a good thing to have in hotels, I'm thinking,' remarked Mr. Hayseed, as he blew out the gas. 'I wonder if I shall live to see it?'"

"OBSERVER" incloses the following mention of the death and career of Mr. Joseph N. Bacon: "Mr. Joseph N. Bacon, President of the Newton and Watertown (Mass.) Gas Light Company, and President of

the Newton National Bank, died, on the morning of the 5th inst., at his late residence, Bacon street, Newton. He was stricken with paralysis on Wednesday, June 3, and never recovered consciousness. He was one of the wealthiest and most prominent citizens of Newton, where he was born January 25, 1813, and where he lived all his life. He was educated in the public schools, and at Phillips Academy, at Andover. He showed a remarkable aptitude for business of many kinds. From 1836 to 1840 he conducted a general store in Newton. He then went into the real estate business, and was the owner of much valuable property, including the Eliot block at Newton and a large farm at Newton Highlands. Besides being President of the two companies above named, he was a Director of the Citizens Mutual Insurance Company and of the Newton Savings Bank, Trustee of the Euphrates College, Karpoot, Turkey, and a deacon, and the oldest living member as well, of the Eliot Congregational Church. He was a member of the old Whig party until 1849, when he voted for Martin Van Buren, as a 'Conscience Whig.' He was postmaster from 1840 to 1849. Few men have been so closely identified with the growth of Newton as Joseph N. Bacon, and he leaves behind him many enduring monuments. He was a man of generosity and philanthropy, giving freely of his money for religious and charitable purposes. He educated many young men. Although 83 years old, his eyesight remained unimpaired, and he never wore eyeglasses even to read. He leaves a widow, one son (William F. Bacon), and a daughter, Mrs. Emma S. Stanton."

An application has been made for the appointment of a receiver to take charge of the properties of the Excelsior Springs (Mo.) Gas Light and Fuel Company.

The engine room of the Atlantic City (N. J.) Gas and Water Company was badly damaged by fire some days ago. A defective union in a naphtha tank was responsible for the outbreak.

The Select Council, of Philadelphia, has referred to the Committee on Law the resolution adopted by the Common Council, which directs that $1,500,000 be appropriated for the improvement of the city gas plant.

The new gas rate at St. Paul, Minn., which went into effect on the 1st inst., is attracting many additional consumers to the St. Paul Gas Company. As before stated in the JOURNAL, the new rate is $1.50 per 1,000 gross, with 20 cents per 1,000 off for prompt payment.

The Hopkinsville (Ky.) Gas Light Company has awarded a contract to the United Gas Improvement Company for one of the latter's standard Lowe water gas settings. The contract also includes provision for a new and complete purifying equipment. This water gas set is to take the place of an oil gas apparatus.

In response to an invitation from the authorities of Mount Pleasant, Iowa, to bid on the public lighting of that place, the proprietors of the Mount Pleasant Gas and Electric Light Works submitted the following proposition: To furnish and keep in repair 65 arc lamps, of 800 candle power each, for $50 per lamp per year, on a lighting table, moon schedule, 17 nights per month to midnight. The bidders also agreed to supply incandescent electric lights, of 16-candle power, to ordinary consumers, at a price not to exceed ¾ cent per meter hour, and to supply gas on the basis of $2 per 1,000 cubic feet on illuminating account; all gas sold for fuel account to be billed at $1.80 per 1,000 cubic feet.

The amalgamation of the gas and electric lighting interests of the cities of Bristol and Warren, Rhode Island, was completed last Saturday.

During May the dividends disbursed on gas shares largely held in San Francisco, Cal., were as follows:

Company.	Rate per Share.	Amount.
Central Gas Light.....	$1.00	$20,000
Oakland Gas Light	.25	7,500
Pacific Gas Improvement.....	.50	15,000
Pacific Lighting	.30	6,000
San Francisco Gas Light.....	.35	35,000

A correspondent at Davenport, Iowa, forwards the following clipping from the Davenport *Democrat* of recent date: "It is given out officially by the officers of the Davenport Gas Light Company that the Walsh Brothers have made a cash payment for the gas plant sufficient in amount to make it certain that the transfer of the plant will be made. This will not occur for some little time, however, and until that time the plant remains under the control and management of the old Company. There is a possibility that the Walsh Brothers will assume their contract for the city lighting in their own name from June 1st, and will hire the old Company to furnish the electricity until the transfer is effected. But conferences have been held with the Mayor and Light Committee of the City Council that may end in a month's extension of the time for the undertaking of their contract by the Walsh Brothers and an equal extension of the duration of the old contract of the Gas Company. The transfer of a plant like that of the Gas Company, it is explained, is not easily made in a day. The stock of the old Company was in the hands of 33 persons, more or less scattered over the country: and bonds to the amount of $64,500 were also scattered in a number of States. Getting things in shape for a sale involved considerable trouble for the selling party. When they had things in shape, and a trust deed had been drawn and was sent East to the Trustees of the bonds of the new Consolidated Company, word came back that the Trustees had found some technical fault with the form of the deed, and the return of the deed with the suggestions for alteration is now being awaited. Until it arrives here and has been changed, returned and approved, the bonds will not be sent on from the East, and they are an essential part of the transaction that will change the ownership of the gas plant. So some time may yet elapse before Messrs. Pendleton, Gaylord and the other stockholders in the old Company can say that they are 'out.'"

At the annual meeting of the shareholders in the Trenton (N. J.) Gas Light Company, the following Directors were elected: Lewis Parker, Edward H. Stokes, Clark Fisher, John S. Chambers and Charles E. Green.

At the annual meeting of the Pawtucket (R. I.) Gas Company these Directors were elected: Jas. G. Fales, Hezekiah Conant, Stephen A. Jenks, Edwin A. Perrin, Lyman M. Darling, Eben N. Littlefield, Frederick W. Easton, Jonathan Chase, Olney Arnold and Darius L. Goff.

After much investigation and debate the price of gas in the District of Columbia has finally been settled, the conferring committees of the House and Senate having agreed upon and passed a schedule which subsequently received the approval of the President. Briefly stated, the Washington Company may charge to ordinary consumers the net rate of $1.10 per 1,000 cubic feet from July 1, 1896, to July 1, 1901; and thereafter the rate is to be $1 per 1,000. In Georgetown the rate, from July 1, 1896, to July 1, 1901, is to be $1.35; thereafter the rate is to be $1.25.

The Metropolitan Street Railway Company, of Kansas City, Mo., will hereafter light its cars with compressed gas of the Pintsch type.

The Coal of Alaska.

Mr. Freeman H. Curtis, who was recently appointed Postmaster at Seward, Coal Bay, Cooks Inlet, Alaska, enjoys the distinction of ruling over the most remote post office of the United States. Mr. Curtis is an expert mining engineer, and was for 18 months continuously located at the coal mines of the North Pacific M. and T. Co., which are but 100 miles from the placer gold diggings on Turnagain Bay. In an interview printed in the San Francisco *Call* he said:

"Both gold and coal have been known to be there for some time, but it is only within the past two or three years that any particular attention has been paid to developing those interests. The coal prospects give great promise, because of both the quality and quantity of the veins. The supply is virtually inexhaustible. It is of the Scotch splint and English cannel variety, being suitable for all domestic purposes and also for all kinds of stationary engines, including marine.

"There is sure to be increasing development in the coal fields on Katchemak Bay from now on. There are about 2,500 square miles of them and all extremely rich. As an example, there are at least 100 veins in sight within 15 miles.

"Our Company has about 8 miles frontage on Coal Bay, and an area comprising 4,000 acres. We have taken out but little coal up to the present time, as most of our work has been confined to developing the mines. We have been at work now for about two years, have expended about $60,000, and have had an average of 50 men employed. The operations being carried on mostly underground, we have been able to keep the men at work throughout the year. We have brought two cargoes of coal down here and found no difficulty in disposing of them. The product was found highly satisfactory and we anticipate no trouble in marketing all that we get out. No attempt has been made to create a market for our coal, as we will not take it out in large quantities until our plant is thoroughly in shape and the work of development well under way. This will soon be the case. In Alaska alone there are about 40,000 tons of coal consumed annually. The government uses about 15,000 tons, the canneries about 20,000, and about another 5,000 tons are needed for domestic and minor purposes. This coal now goes there from here and from the Sound ports. That we will be able to control the market for the kind of coal we will have to offer I am sure, for this coal is now selling for $8 a ton, and we can afford to sell our product for $4 a ton and make a fair profit."

THE AMERICAN GAS LIGHT JOURNAL

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MONDAY, JUNE 15, 1896.

Ignitibility of Wood Charred by Steam.

Cassier's for June, referring to the much discussed question whether wood, charred by long-continued contact with hot steam pipes, and thus brought into a state in which even a slight touch will reduce it to powder, will ignite from any cause except actual contact by spark or flame from an outside source, says that Mr. Edward Atkinson, President of the widely known Boston Manufacturers' Mutual Fire Insurance Company, cites an interesting example from his own experience. He says: "Having had occasion to test heat retarding substances on my own behalf, I once obtained some sections of beautifully prepared wood pulp, in slabs of 1½ inches in thickness and of a very porous quality, which are made use of in the construction of refrigerators. My purpose was to determine whether or not such slabs could be used to prevent the escape of heat from a lamp oven. I therefore raised the heat of my inner oven, which is a tight iron box, 1 inch distant on all sides from an outer case made of vulcanized and very solid wood pulp, to a little under 400° F. In the center of that inner oven, isolated from any metallic contact with the walls, I placed one of these slabs and there left it, subject to heat at less than 400° F., for about one hour. I then removed the front of the outer oven and opened the door of the inner oven, letting a very quick and large supply of fresh air into the chamber in which the oxygen had probably been, in part, exhausted by subjection to the hour's heat. The slab of wood pulp had turned from pure white to dense black, having been converted into very porous charcoal. In less than a minute after the fresh air was let in it took fire and burned to ashes before my eyes. I then repeated the experiment with the same result. Four hundred degrees F. will be developed by a pressure of steam of 238 pounds per square inch, but the same carbonization ensues by lapse of time even at boiling heat at 212° F." The conclusion to be drawn from this is evident.

The Indiana Natural Gas Field.

In his annual report, just published, State Geologist Blatchley says that there is no doubt that one-half of the supply of natural gas in Indiana has been nearly or quite exhausted. He shows that the original gas area comprised about 5,000 square miles, and the average initial of rock pressure nine years ago was 329 pounds to the square inch. To-day the main gas field of Indiana contains an approximate area of but 2,500 square miles, with an average pressure of 230 pounds to the square inch. This diminution in pressure is most noticeable in the cities which receive their supply of gas through pipe lines. As there can be no increase, the pressure is likely to decrease even more rapidly in the future. How long the supply will last no man can tell. If the waste which has been going on so extravagantly in the past can be stopped, however, Mr. Blatchley thinks that the supply in the heart of the field, where a considerable amount of undeveloped territory has been held in reserve, may probably last for a number of years. The State Natural Gas Supervisor, J. C. Leach, in his report says: "The fact that we have entered on a period of decline, that the supply is failing, and will finally be exhausted, is not questioned. The main fact settled by the history of the Pennsylvania and Ohio natural gas fields is that a reservoir of natural gas can be exhausted." He does not find it possible, however, to make anything like an accurate prediction in regard to the probable life of the Indiana field. Several factors, including the dominant one of wastage, enter into this question.

A Material for Staining Steel.

A writer in *English Mechanic* recommends the following direction for oxidizing and blacking the bright work of steel in lieu of paint, to stand heat and to wear well: Take 3 ounces of glacial acetic acid, mix it with its weight of water, to this add ½ ounce of powdered nut galls, and let it stand for a day or two, shaking it up occasionally. Then let settle, then pour off the clear, then put a pint of boiling water to the residue. When cold and settled, pour off the clear and mix with the first. Now to this add a grain of nitrate of silver or sulphate of copper or nitrate of copper. Dissolve whichever you use in a little hot water before mixing with the other liquid. Silver is the best process. Clean all oil off and rust or scabs, paint, etc. Clean all up bright with pumice stone powder. Don't use emery in any form, but the above with a piece of wood. Then clean all off; dry with air-slaked lime. Now go over it with the liquid with some cotton wool. If you have saved your powdered galls, take a little of that upon your wool, and will find that a great acquisition in the first application. Let stand until dry; then give it another coat. When dry, scratchbrush it, and give it another coat, etc. When you have got it to your liking, give it some linseed-oil and camphor. All bright iron parts can be made like ebony polished, and with the gun-metal mounting you will have a picture in black and gold. Cylinder covers, etc., can be done the same; but you must wash with hot water before oiling it. It will stand any amount of heat, the hammer and friction in wiping; you have no blistering, and you will have some difficulty in eradicating it. Bicycles, repairs, handle-bars, etc., can be treated the same way to advantage, well washed with hot water; when dry give them a coat of good copal carriage varnish.

The Market for Gas Securities.

Dullness ruled in city gas shares during the week, and weakness was also a characteristic of the market. Consolidated nominally sold down to 153, but afterwards recovered to 155. The opening to-day (Friday) was 154½ to 155½. The weakness in Consolidated is due to manipulation, which comes easy to certain speculators, when they can adjust to their aid a badly mixed up general market. Of course, the great majority of the readers of this column in the JOURNAL are not in any sense speculators, so it is not of any moment to advise them in respect of the danger of going short of Consolidated. We do, however, unhesitatingly recommend the purchase of the stock at anything under 160, and we imagine that a *bona fide* order to purchase 500 shares of cash stock could not be filled to day at an average of less than 160. The Company's affairs were never in better condition, and it is also our pleasing task to say that President Gawtry is himself again, which insures a continuance of his sterling management of the Company's affairs. Equitable is steady, at 210 to 215, and Mutual is a shade easier, at 225 to 235. The Standard issues are well maintained in point of values, and New York and East River specialties are also better than at previous time of writing. Chicago is dull and weak, at 67½ to 67¾. These shares are undoubtedly a purchase, for no one need be surprised if a dividend were declared at any time. The treasury surplus is sufficient to stand the drain of a 4 per cent. disbursement. Consumers, of Jersey City, is said to be offered at 78. Consolidated, of Baltimore, is at 62½ to 63 ex. div., and Brooklyn Union is slow, at 90½ to 91. Laclede common is quoted at 22½ to 22¾, and Bay State common is a good thing to look at—the value of it to day is said to be 27½ to 27¾.

Gas Stocks.

Quotations by Cochran & Close, Brokers and Dealers in Gas Stocks,

35 WALL ST., NEW YORK CITY.

JUNE 15.

☞ All communications will receive particular attention.

☞ The following quotations are based on the par value of $100 per share.

N. Y. City Companies.	*Capital.*	*Par.*	*Bid.*	*Asked.*
Consolidated	$35,430,000	100	154½	155½
Central	500,000	50	150	..
" Scrip	220,000	..	100	.
Equitable	4,000,000	100	..	212
Bonds, 6's	1,000,000	1,000	105	..
" 1st Con. 5's	2,300,000	1,000	114	.
Metropolitan Bonds	658,000	..	108	112
Mutual	3,500,000	100	225	235
" Bonds	1,500,000	1,000	100	102
Municipal Bonds	750,000	.	..	.
Northern	150,000	50	79	80½
" Bonds	150,000	1,000	..	98

New York and East River..	5,000,000	100	37	38
Preferred.....	2,000,000	100	70	75
Bonds 1st 5's.....	3,500,000	1,000	102	108
" 1st Con. 5's.....	1,500,000	..	90	92
Richmond Co., S. I.....	348,650	50	50	..
" Bonds.....	100,000	1,000	..	..
Standard.....	5,000,000	100	78	80
Preferred.....	5,000,000	100	107	109
Bonds, 1st Mortgage, 5's	1,500,000	1,000	109½	111½
Yonkers.....	200,650	50	130	..
Out-of-Town Companies.				
Brooklyn Union.....	15,000,000	100	90¼	91
" " Bonds (5's)	15,000,000	1,000	105¼	105¾
Bay State.....	5,000,000	50	27¾	27¾
" Income Bonds.....	2,000,000	1,000	..	42
Boston United Gas Co.—				
1st Series S. F. Trust....	7,000,000	1,000	84	85
2d " " "	3,000,000	1,000	66	70
Buffalo Mutual.....	750,000	100	125	..
" Bonds.....	200,000	1,000	95	100
Central, San Francisco.....	2,000,000	..	95	..
Chicago Gas Co.....	25,000,000	100	67⅛	67¾
Chicago Gas Lt. & Coke Co. Guaranteed Gold Bonds.	7,650,000	1,000	94	94¼
Columbus.....	1,000,000	..	..	65
1st Mortgage.....	1,085,000	..	..	96
Consumers, Jersey City....	3,000,000	100	..	78
" Bonds.....	600,000	1,000	99	100
Cincinnati G. & C. Co.....	7,000,000	100	198¾	200
Consumers, Toronto.....	1,800,000	50	184½	187
Capital, Sacramento.....	500,000	50	..	41
Bonds (6's).....	150,000	..	..	..
Consolidated, Baltimore....	1,000,000	100	62½	63
Mortgage, 6's.....	3,600,000	..	107	107½
Chesapeake, 1st 6's.	1,000,000	..	..	..
Equitable, 1st 6's.	910,000	..	..	..
Consolidated, 1st 5's.....	1,400,000	..	..	..
Detroit	4,000,000	..	..	29
" Con. Bonds.....	4,312,000	..	76	77
Equitable Gas & Fuel Co., Chicago, Bonds.....	2,000,000	1,000	..	101
Fort Wayne	2,000,000	..	87	90
" Bonds.....	2,000,000	..	93	95
Hartford.....	750,000	25	..	145
Indianapolis.....	2,000,000	..	132	136
" Bonds, 6's.....	2,650,000	..	104	105½
Jersey City.....	750,000	20	180	..
Lafayette Gas Co., Ind.....	1,000,000	100	94	96½
Bonds.....	1,000,000	1,000	94	97
Louisville.....	2,570,000	50	..	130
Laclede, St. Louis.....	7,500,000	100	22¼	22⅝
Preferred.....	2,500,000	100	..	83
Bonds.....	9,084,400	1,000	92	93
Little Falls, N. Y.....	50,000	100	..	100
Bonds.....	25,000	..	..	100
Montreal, Canada.....	2,000,000	100	200	..
Newark, N. J., Gas Co.....	1,000,000	..	93	98
Bonds, 6's	4,000,000	..	128	..
New Haven.....	1,000,000	25	225	..
Oakland, Cal.....	2,000,000	..	52	53¼
" Bonds.....	750,000	..	..	..
Peoples Gas Lt. & Coke Co., Chicago, 1st Mortgage....	2,100,000	1,000	..	108
2d "	2,500,000	1,000	104	105
Peoples, Jersey City.....	500,000	50	..	175
Paterson, N. J.....	.....	25	99	102
Rochester Gas & Elec. Co..	2,150,000	50	..	..
Preferred.....	2,150,000	50	88	..
Consolidated 5's.....	2,000,000	..	87½	90
San Francisco, Cal.	10,000,000	100	93¾	94
St. Paul Gas Light Co.....	1,500,000	100	67½	70
1st Mortgage, 6's.....	650,000	..	84	87
Extension, 6's.....	600,000	..	..	..
General Mortgage, 5's..	2,400,000	.	88	90
Syracuse, N. Y.	500,000	25	..	..
Washington, D. C.....	2,000,000	20	250	..
Western, Milwaukee.....	4,000,000	100	65	67
Bonds, 5's.....	3,556,000	.	89	91
Wilmington, Del.....	500,000	5	188	190

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Gas Engineering Co., Pittsburgh, Pa..... 988

GAS METERS.

John J. Griffin & Co., Phila., Pa..... 996
American Meter Co., New York and Philadelphia..... 995
The Goodwin Meter Co., Phila., Pa..... 994
Helme & McIlhenny, Phila., Pa. 995
D. McDonald & Co., Albany, N.Y..... 995
Nathaniel Tufts, Boston, Mass..... 994
Maryland Meter and Mfg. Co. Baltimore, Md..... 994
Metric Metal Co., Erie, Pa 994
Keystone Meter Co., Royersford, Pa..... 976
The Hillen Meter Co., Brooklyn, N. Y..... 995
Buhl Stamping Company, Detroit, Mich..... 972

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Wm. Anderson, East Boston, Mass 972

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H. E. Parson, New York City..... 987

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Berwind-White Coal Mining Co., New York and Phila... 984

CANNEL COALS.

Perkins & Co., New York City..... 984
Macfarlane & Co., Louisville, Ky..... 972

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Standard Oil Co., New York City..... 985
The Sun Oil Co., Pittsburgh, Pa..... 985

COKE CRUSHER.

C. M. Keller, Columbus, Ind..... 985

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C. W. Hunt Company, N. Y. City..... 973

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The Bristol Co., Waterbury, Conn..... 973

GAS GOVERNORS.

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Isbell-Porter Co., New York City..... 990
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Baltimore Retort and Firebrick Co., Baltimore, Md..... 986
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Brooklyn Firebrick Works, Brooklyn, N. Y..... 986

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C. L. Gerould & Co., Mount Vernon, N. Y..... 986

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Welsbach Commercial Co., Phila., Pa..... 975

MICA GOODS.

The Mica Mfg. Co., New York City..... 972

BURNERS.

C. A. Gefrorer, Phila., Pa..... 990

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Isbell-Porter Company, New York City..... 990
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Chapman Valve Manufacturing Co., Boston, Mass..... 932
R. D. Wood & Co., Phila., Pa..... 990
Continental Iron Works, Brooklyn, N. Y..... 990
The P. H. & F. M. Roots Co., Connersville, Ind..... 980
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The Western Gas Construction Co., Fort Wayne, Ind.... 982

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Backus Water Motor Co., Newark, N. J..... 932

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William M. Crane & Co., New York City..... 976
Keystone Meter Co., Royersford, Pa..... 976
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CHINA GAS KILNS.

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New York Marine Paint Co., Poughkeepsie, N.Y..... 982

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Bartlett, Hayward & Co., Baltimore, Md..... 989
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Kerr Murray Mfg. Co., Fort Wayne, Ind..... 988
Stacey Mfg. Co., Cincinnati, Ohio. 991
R. D. Wood & Co., Philadelphia, Pa..... 990

DIVIDEND NOTICE.

OFFICE OF WELSBACH LIGHT CO.,
DREXEL BUILDING, PHILA., June 10, 1896.

The Directors have this day declared a dividend of twenty (20) per cent., payable on June 26, 1896, to stockholders of record at the close of business June 19. Checks will be mailed.

N. B.—The transfer books close from June 20 to July 10, both inclusive, for the annual meeting.

1097-2 EDWARD C. LEE, Treasurer.

Position Wanted

Experienced man desires position as Superintendent of Gas Works or Gas and Water Works combined, or Gas and Electric Light Works combined, or separate construction of either. Supt. of combined plants nearly 7 years. Twenty-five years' practical experience. First-class references.

Address "G. H. H.," 3222 Pacific Avenue,
1095-3 Tacoma, Wash.

WANTED,

By a young man of 30 years' experience, a position to take full charge of gas works, or Superintendent of manufacturing and distribution. Coal gas works preferred, especially where regenerative benches are in use or can be introduced. All-round man in all branches of the business. Have sold 30 gas ranges so far this season; 500 Welsbach lights now in use in town of 15,000 population. Competent and reliable references as to ability and character. Salary reasonable. Best of reasons for desiring a change. Address

1095-4 "T. H. S.," care this Journal.

Position Wanted

As Superintendent of Gas Works or Gas and Electric Light Works.

Has been in the employ of the Long Branch (N. J.) Lighting Company as Superintendent for the last 11 years, and is a practical mechanic, thoroughly understanding the laying out and erection of plant and the making of coal and water gas. Best of references. Address CHAS. J. LUTHER,

1097-2 Box 142, Long Branch, N. J.

For Sale.

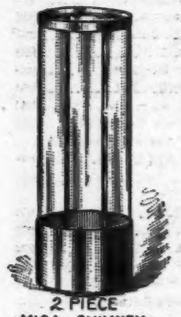
A Small Gas and Electric Light Plant,

in a Southern city of 3,800 inhabitants.

Address FORT WAYNE ELECTRIC CORPORATION,

1097-tf Fort Wayne, Ind.

Our Mica Chimneys



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Etched Chimneys to Order.

For Welsbach Lights ARE THE BEST IN THE WORLD.

Get Catalog and Discounts.

The MICA MFG. CO.

Micasmiths,

88 Fulton Street, N. Y. City.

FOR SALE,

One 8-ft. Station Meter, with 12-in. connections. In good order. Can be delivered Aug. 1.

One Oil Tank, 29 ft. long, 5 ft. 6 in. diameter.

One No. 4 Wilbraham Blower.

Wrought Iron Hydraulic Main for six benches of 6's. Size of Main, 24 in. by 30 in; 8 feet casings. Arranged for 7-inch dip-pipes.

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FOR SALE,

Two No. 2 Baker Blowers, in first-class condition; one nearly new.

A Snell & Meharg 25 H.P. Horizontal Engine, in good condition.

A Westinghouse Automatic Engine, 25 H.P., 7¼ x 7, which needs some new parts. Can be seen in operation at the Works of the

PASSAIC LIGHTING CO.,
1095-4 Passaic, N. J.

Special Prices on BEAR CREEK CANNEL COAL

will be made during the dull summer months. It will pay you to get your Cannel housed in good weather and at the lowest price. Find out about it.

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Utilize Your Gas Liquor.

NO EXTRA LABOR OR OPERATING EXPENSES.

Ammonia Concentrator.

Not Expensive. Write to STROH & OSIUS, Pat'ees, or Mich. Ammonia Works, Detroit, Mich.

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Made in all sizes.

Will cut from 2 in. to 24 in.

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For Cutting Cast, Wrought Iron, Gas & Water Pipes.

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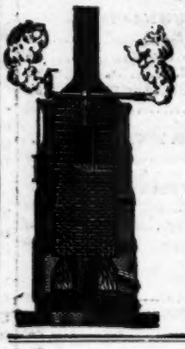
The Pioneer Vertical Water-Tube Boiler of the World!



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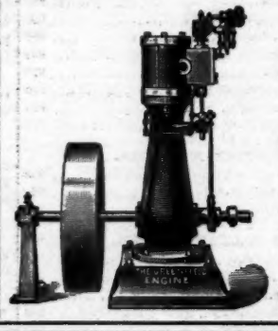

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Also Horizontal, Automatic and Variable Cut-off Engines.
Sizes from 3 to 75 Horse Power.
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THEODORE D. BUHL, President. CHARLES H. JACOBS, Vice-Pres't and Managing Director.

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THE ONLY METER FACTORY IN THE WORLD WHICH MANUFACTURES ITS OWN TIN PLATE.

THE GREATEST IMPROVEMENT IN GAS LIGHTING
Has been made by
WILDER'S VOLUMETRIC GOVERNORS.
They control the pressure at the burner, and deliver the quantity for which they are set regardless of high or low pressure in the supply.
WELSBACH LIGHTS are fully controlled, and the governors soon pay for themselves by preventing the breaking of mantles and chimneys. Thousands are already in use. Orders may be given to the Welsbach Co., or sent to ourselves.
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UNIFORMITY GUARANTEED.
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HERMAN POOLE * Chemical Engineer,
323 West 34th Street, N. Y. City,
Makes a Specialty of
PURIFICATION
And the Utilization of Waste Products in Gas Manufacture.

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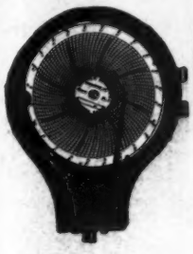
For Continuous Records of
Street Gas Pressure.
Simple in Construction,
Accurate in Operation,
Low in Price,
Fully Guaranteed.
Send for Circulars.
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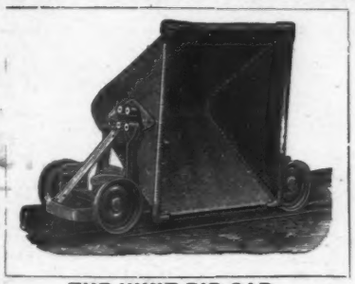
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COKE CARS for Gas Works,
TIP CARS for Carrying Ashes,
CHARGING CARS for Bringing Coal from the Storage Bins to Boiler Room and Retort Houses.
INDUSTRIAL RAILWAYS
Specially designed for handling material in and around
Gas Works, Coal Yards, Factories, Etc., Etc.
45 BROADWAY, - - NEW YORK.

AMERICAN GAS COMPANY,
222 South Third Street, Philadelphia, Pa.
Owns, Operates, Buys and Leases Gas Works.

ALSO UNDERTAKES ALL KINDS OF CONSTRUCTION WORK.
Especially the Installation or Extension of Plants for the Manufacture of Gas from Caking Coal.

The attention of Gas Managers is particularly called to the many improvements in this method of manufacture instituted during the past fifteen years, and the extremely low cost at present of Coal Gas.

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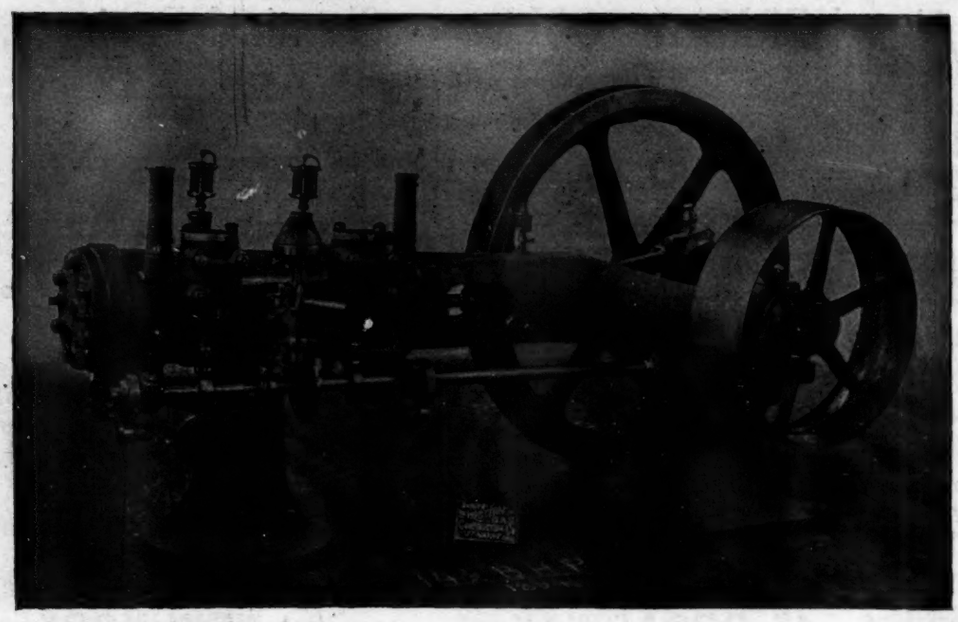
THE AMERICAN GAS ENGINE CO.,

MANUFACTURERS OF

The Double-Acting Gas Engine,

Under the Patents of Griffin, and Dick, Kerr & Co., of London and Kilmarnock.



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Single Cylinder.

Impulse Every Revolution.

(Two Strokes.)

15 to 500 Horse Power.

For General Work and Isolated Electric Plants.

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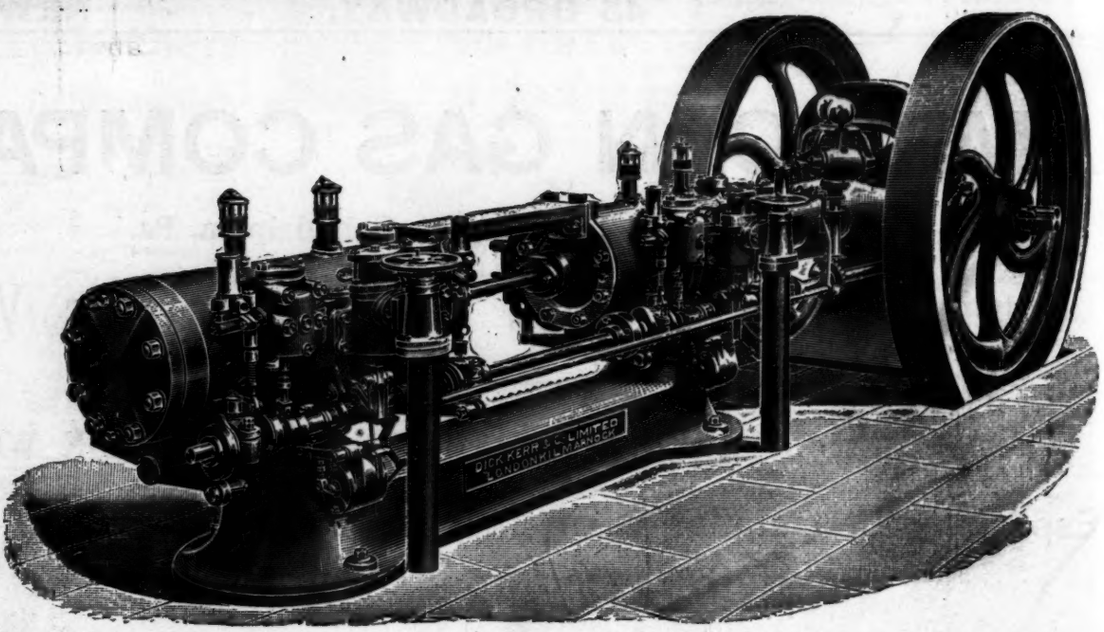
Tandem Cylinder. Impulse Every Stroke. 100 to 1,000 Horse Power.

For Central Stations and all work requiring extreme steadiness.



ESSENTIAL PRINCIPLE.—An impulse at each end of piston; using half force to each impulse; doubling the steadiness; reducing the wear on moving parts, and weight for given power. **CONSTRUCTION.**—The piston rod works through stuffing box in front end of cy inder, and connecting rod is carried in a cross-head working in a slide in frame, as in ordinary steam engine practice. All valves are of the poppet type, operated by cams on a single cam-shaft, giving positive movement to every working part. Tube or electric ignition. **RESULT.**—An engine of extreme simplicity and steadiness of action, the even wear on the cylinder and all working parts assuring increased economy, long life, and minimum cost in repairs. **RECORD.**—Successful and constant use in Great Britain for the past eight years. Address

W. W. GOODWIN, President, 532 Bourse Building, Philadelphia Pa., or
THE WESTERN GAS CONSTRUCTION CO. Bldrs. & Gen. Agts. Fort Wayne Ind.

THE

New and Improved Welsbach Light.

No. 34 Light, with No. 10 and No. 43 Opal Shade.

CAUTION!

BEWARE of counterfeit lights which are being offered in genuine Welsbach boxes. See that each box bears our trade mark, "WELSBACH," and that the seals are unbroken before you accept it.

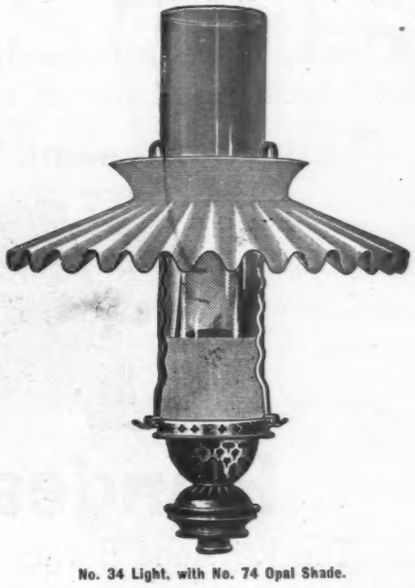
CAUTION!!

Persons dealing in counterfeit lights are liable to criminal prosecution, and a large number of indictments have already been found against such dealers.

All infringements of this Company's patents will be promptly and vigorously prosecuted, dealers and users being equally liable. This Company will prosecute all parties in whose possession infringing lights are found.

This notice is given in view of an effort now being made to introduce into this country infringing lights made in Germany, the sale of which, there, has been prohibited by the recent decision of the German Patent Office sustaining the validity of the Welsbach patents.

For your own protection, see that you get the genuine Welsbach light, as both the counterfeit and the infringing lights are greatly inferior.



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Welsbach Commercial Co.,

DREXEL BUILDING, PHILADELPHIA.

We Make Everything in the Line of Gas Appliances.

The Vulcan Combination Hot Water Boiler.

FOR GAS AND COAL. ECONOMY IN CONSUMPTION LOWEST ON RECORD.

Can be Connected with Coal Range or Run Independently by Gas.

The advantages of this Boiler cannot be overestimated.

Economy in consumption of gas, lowest on record.

With the double connection, hot water can be obtained from the use of the coal range or independently by using gas attachment.

Takes up no more room than the ordinary boiler, which it supplants entirely.

There is always complete circulation with the coal range, and also the coil which is heated by the gas.

When the gas is used hot water can be drawn *from any part of the house in three or four minutes* after the gas is lighted.

For instantaneous results the consumption of gas is 24 feet per hour. When a continuous supply of hot water is required for the ordinary family use the consumption of gas need not exceed 48 feet per day.

W. M. CRANE & CO.,

MANUFACTURERS,

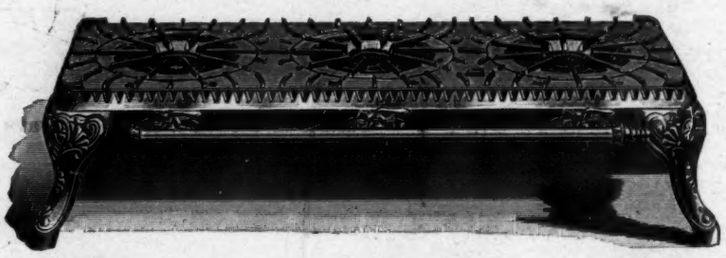
Office, 838 Broadway, New York City.

Factory, 447-453 W. 14th Street.

IN THE RUSH LINE

of hot weather activity---the KEYSTONE GAS STOVES. Their good qualities have been noised abroad, and there is an unceasing demand for these

Convenient, Effective, Economical and Cheap



Ranges and Hot Plates.

The Keystone Burner will do the most hard work in the briefest time, and use every cubic inch of gas consumed to the best advantage. Write us about it. Grade high. Price low. Appearance æsthetic. Sales quick and sure.

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A few of the world's best Gas Stoves. All prominent demonstrators of cooking use them. Nine-tenths of the Chicago apartment houses are furnished with the same . . . . . .

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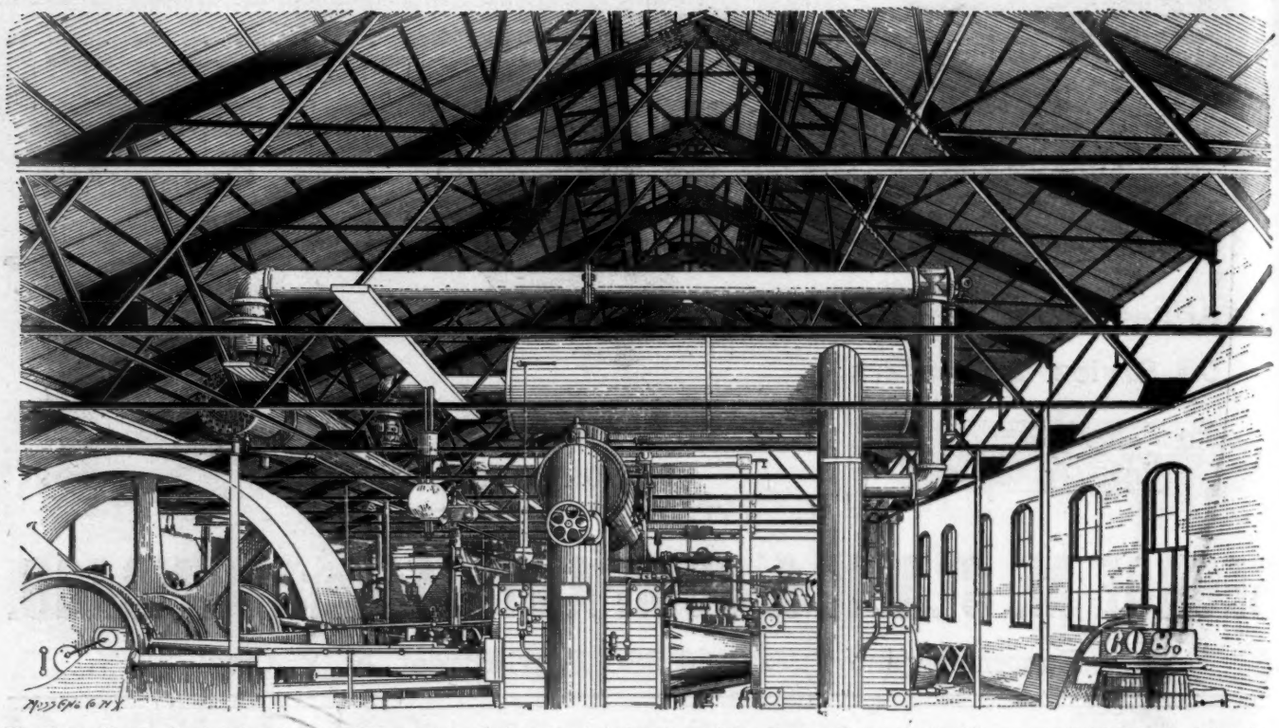

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ADVICE AS TO IMPROVEMENT OF GAS PROPERTIES AND MANAGEMENT.

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Price $1.

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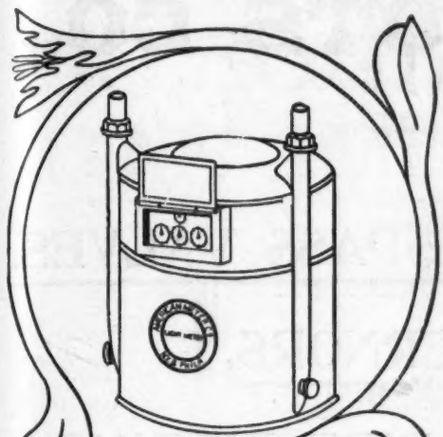

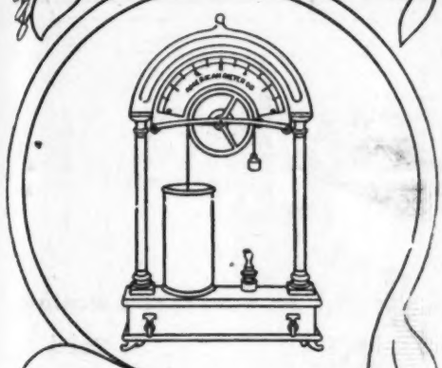

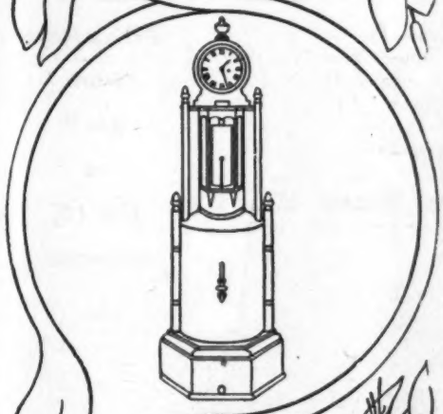

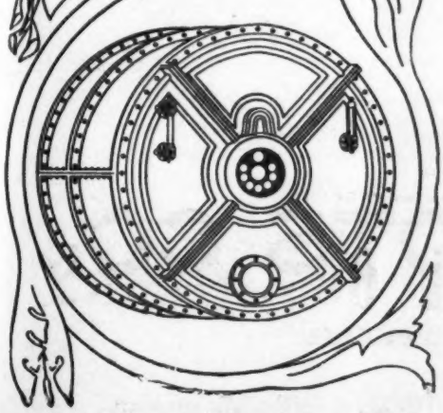

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AMERICAN METER CO.

ESTABLISHED 1834. INCORPORATED 1863.

NEW YORK AND PHILADELPH'A,

CHICAGO, ST. LOUIS,

SAN FRANCISCO.

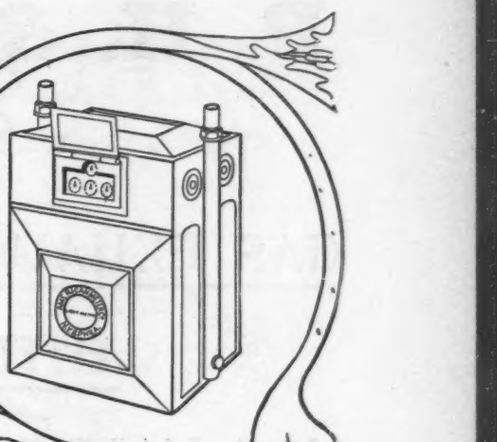
PUBLIC LIGHTING TABLE.

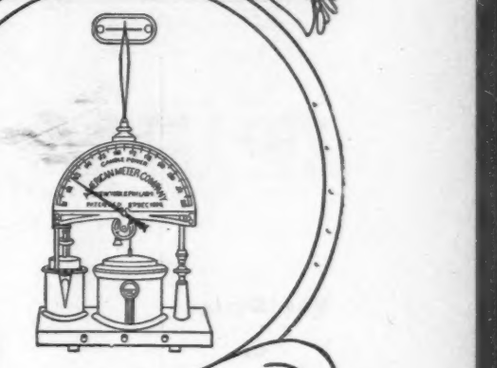
JUNE, 1896.

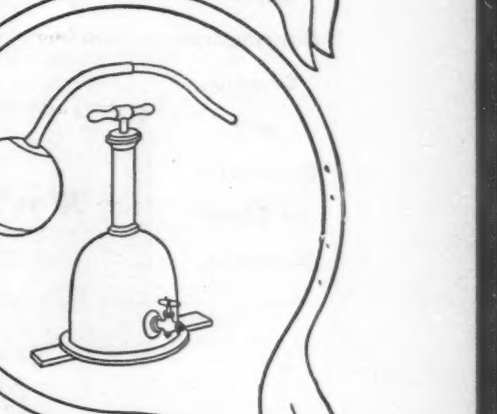
Day of Week.	Table No. 1. Following the Moon. Date.	Light.	Extinguish.	Table No. 2. New York City. All Night Lighting. Light.	Extinguish.
				P.M.	A.M.
Mon.	1	7.50 PM	1.00 AM	7.15	3.15
Tue.	2	7.50 LQ	1.20	7.15	3.15
Wed.	3	7.50	1.40	7.15	3.15
Thu.	4	7.50	2.00	7.25	3.15
Fri.	5	7.50	2.20	7.25	3.15
Sat.	6	7.50	2.50	7.25	3.15
Sun.	7	8.00	3.30	7.25	3.15
Mon.	8	8.00	3.30	7.25	3.15
Tue.	9	8.00	3.30	7.25	3.15
Wed.	10	8.00 NM	3.30	7.25	3.15
Thu.	11	8.00	3.30	7.25	3.15
Fri.	12	8.00	3.30	7.25	3.15
Sat.	13	8.00	3.30	7.25	3.15
Sun.	14	8.00	3.30	7.25	3.15
Mon.	15	10.00	3.30	7.25	3.15
Tue.	16	10.20	3.30	7.25	3.15
Wed.	17	10.50 FQ	3.30	7.25	3.15
Thu.	18	11.10	3.30	7.30	3.15
Fri.	19	11.40	3.30	7.30	3.15
Sat.	20	12.10 AM	3.30	7.30	3.15
Sun.	21	12.50	3.30	7.30	3.15
Mon.	22	1.30	3.30	7.30	3.15
Tue.	23	No L.	No L.	7.30	3.15
Wed.	24	No L. FM	No L.	7.30	3.15
Thu.	25	No L.	No L.	7.30	3.15
Fri.	26	8.00 PM	10.00 PM	7.30	3.15
Sat.	27	8.00	10.30	7.30	3.15
Sun.	28	8.00	11.00	7.30	3.15
Mon.	29	8.00	11.20	7.30	3.15
Tue.	30	8.00	11.40	7.30	3.15

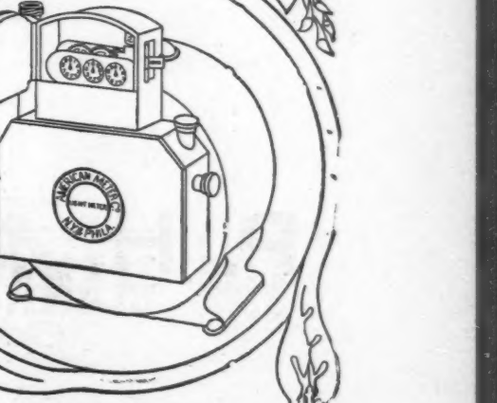
TOTAL HOURS LIGHTING DURING 1896.

By Table No. 1.	Hrs. Min	By Table No. 2.	Hrs. Min.
January	220.40	January	423.20
February	207.00	February	367.40
March	193.00	March	355.35
April	174.10	April	298.50
May	164.00	May	264.50
June	142.10	June	234.25
July	142 10	July	243.45
August	150.50	August	280.25
September	163.00	September	321.15
October	193.10	October	374.30
November	207.00	November	401.40
December	237.30	December	433.45
Total, yr.	2194.40	Total, yr.	4000.00









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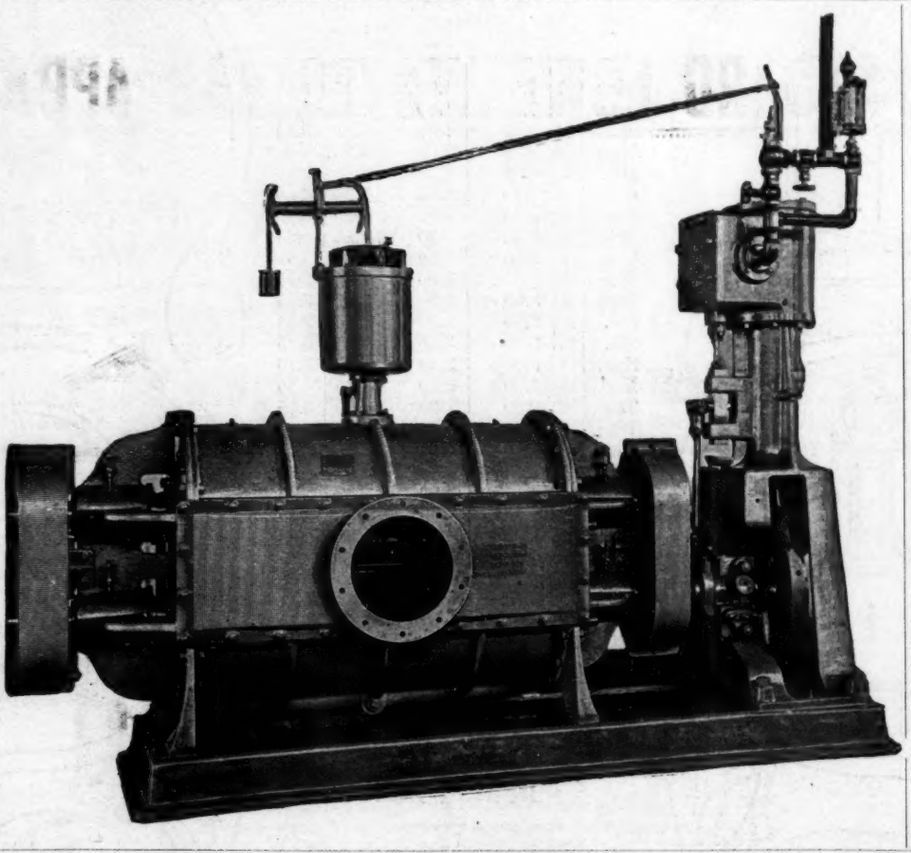

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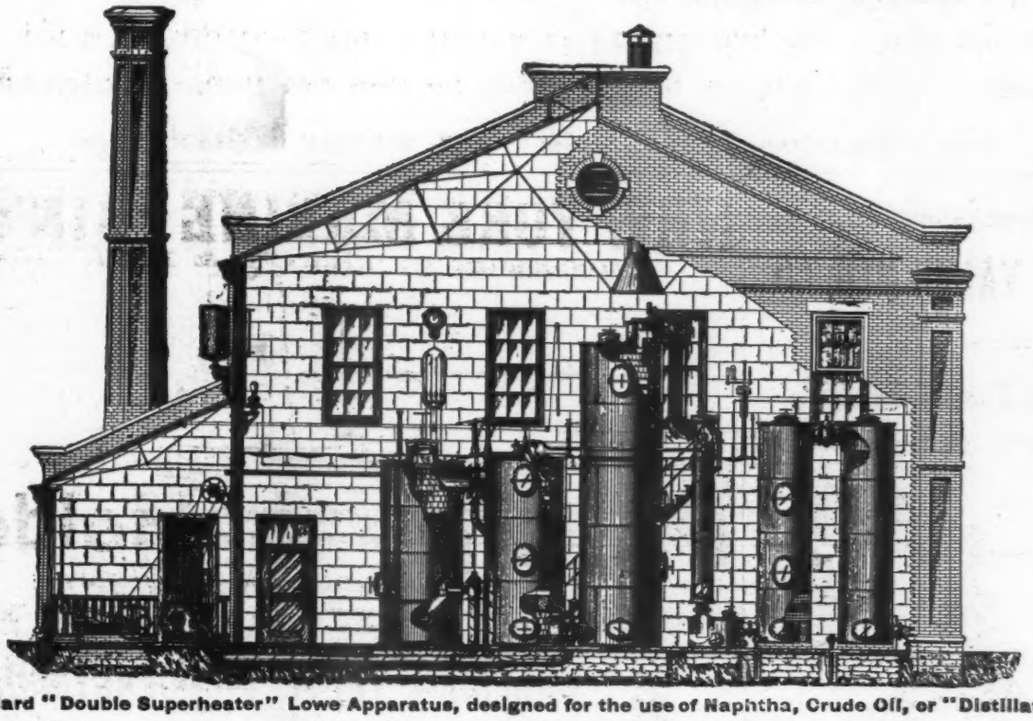

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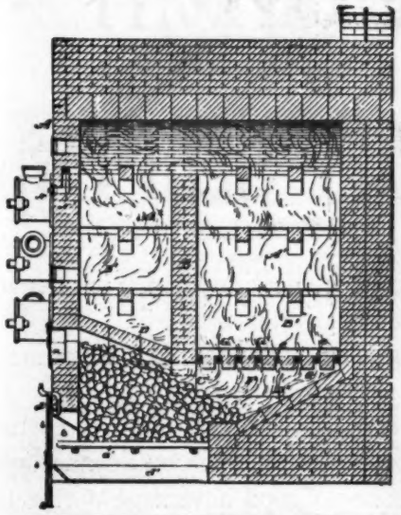

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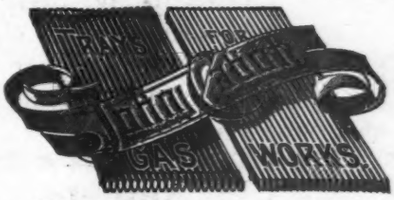

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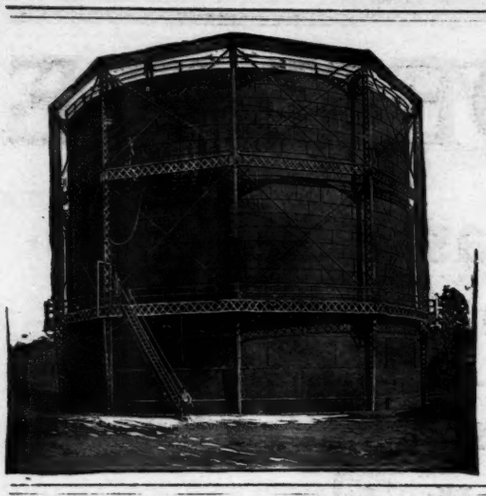

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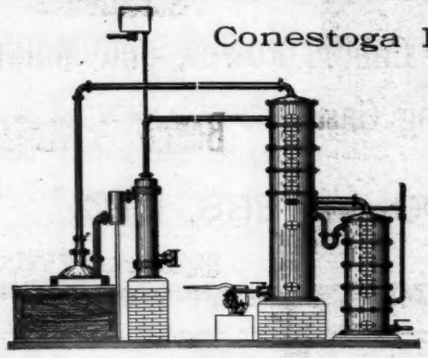

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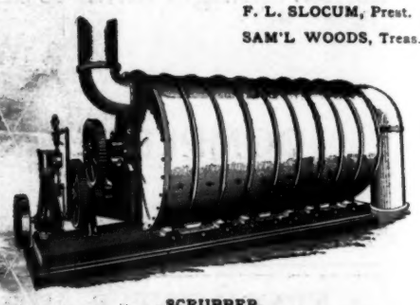

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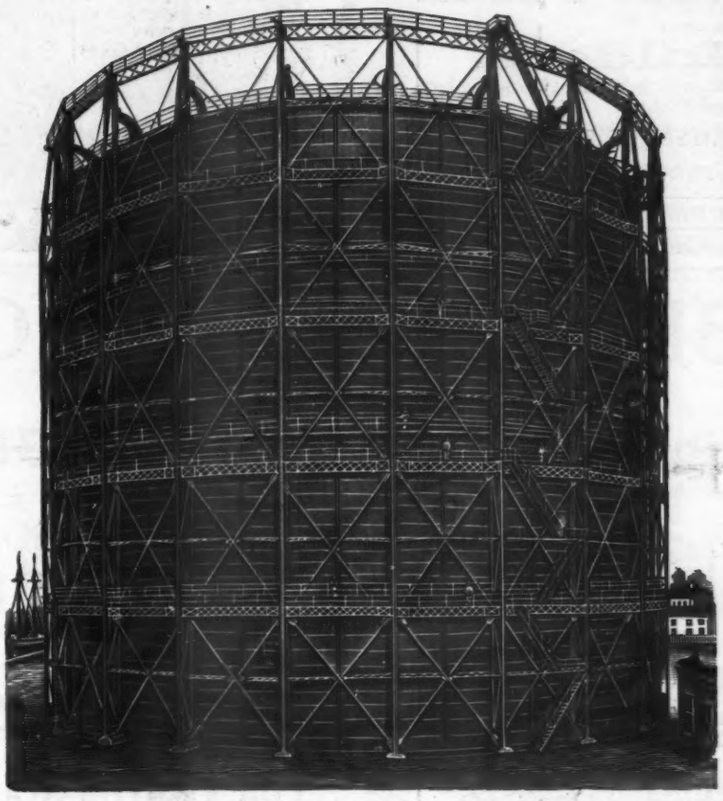

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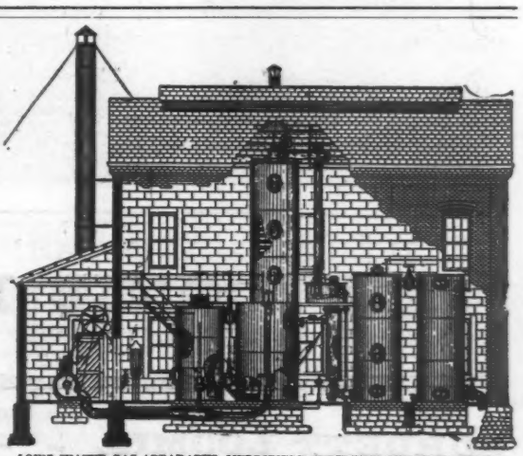

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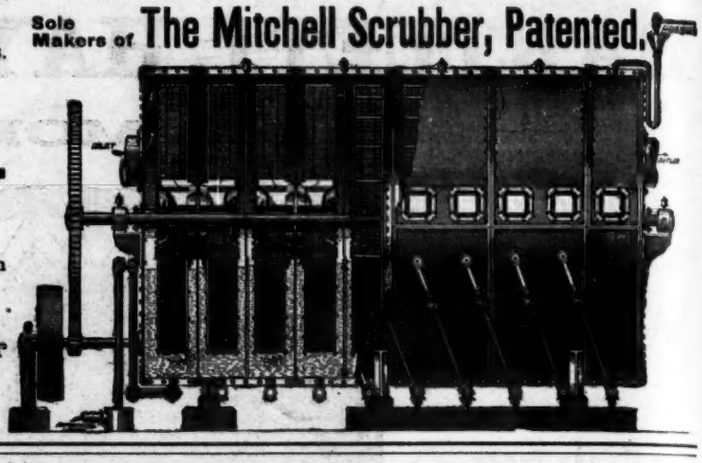

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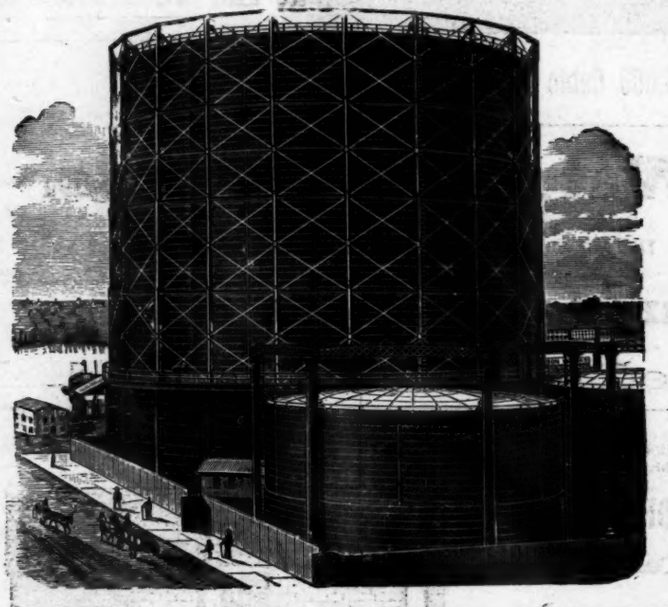

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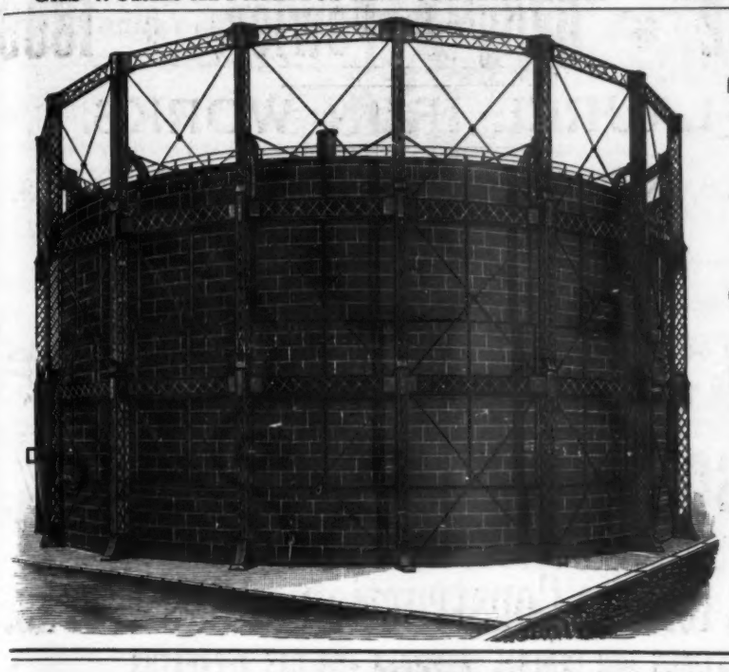

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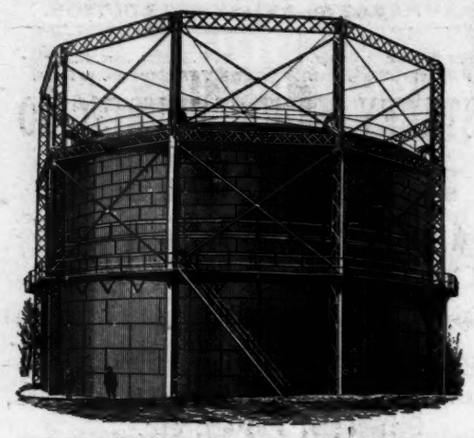

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